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AN INDUSTRIAL OBJECT LESSON.

By S. N. D. NORTH.

THE past year was one of unusual disturbance in England, in the relations of labor and capital, and the chief of these industrial conflicts possessed a significance never anywhere surpassed. The lockout of the engineers—we call them machinists in this country—marks the new alignment of organized labor and organized capital—what may be called the secondary stage of the labor question—more sharply, more tensely, than ever before. A glance at the underlying causes of the engineering lockout will afford a clear conception of the form in which "the labor question" presents itself for the solution of the twentieth century.

There have been strikes that involved a larger number of workers, as the great coal strike of 1893, and the London dock strike; strikes that have lasted longer; strikes that have been costlier; strikes that have developed more bitterness of feeling. There has been no previous collision which, brushing aside all questions as to wages, reached down so closely to the root of the problem, and spread open to public knowledge the real essence of the difference which threatens the productive forces of modern times. The engineers' strike furnishes a concrete illustration of the immensity and the perplexity of the unsettled issue of modern industrialism.

Broadly speaking, labor strikes are of two kinds. The great mass of them, hitherto, have belonged in the simpler group, and have had to do with the wage question only; they are simple, however serious and complicated they may outwardly be, because they turn upon a single economic fact. When employers insist that certain rates of wages are necessitated by existing business conditions, and

the employed deny this, there is a definite fact at issue; and such strikes are coming more and more to be settled in accordance with what that fact is found to be. It is not often that a strike succeeds, when the employers are able to show that the wages demanded can only be paid by carrying on business at a loss. We can prognosticate with certainty about capital, that it will not carry on business indefinitely at a loss—if for no other reason, because it soon eats itself up. Another thing quite as certain is that capital will not indefinitely prolong a conflict with labor at a time when it is possible to effect adjustments by which it can continue to produce at a fair profit. These are two laws which experience has evolved out of this class of labor disputes.

The engineers' strike presented an entirely different phase of the labor problem. It was never a direct quarrel over dollars and cents; the question of wages, while indirectly involved, was subordinated to another, which, if we analyze it carefully, we shall find to be this: Which of the two parties in interest shall control the business that labor and capital jointly carry on? The labor problem in England has reached precisely this stage, and the engineers' strike was, in fact and in essence, a contest for the control of the management of the works, and the conditions under which these enterprises shall be carried on. This is a very broad way of stating the case, but it is essentially fair to both parties. It is always easy to recognize, in any labor dispute, the difference between contention for redress of legitimate grievance, as to wages or otherwise, and contention for control and direction and limitation over the management and conduct of manufacturing enterprises. This difference has distinguished and differentiated the engineers' strike from most of the great labor conflicts which have preceded it in England. It was, from start to finish, a contest over a great economic principle—a principle which lies at the foundation of modern industrialism. The whole long struggle has been singularly free from any collateral questions tending to hide or minimize its real significance. Both sides understood it; both prepared for a battle royal; both were ready to wage it to the bitter end; and thus it has been a dogged, determined, remorseless test of endurance over a vital issue of business economics, while the world looking on has only vaguely sensed its true meaning, or has missed it altogether.

It is impossible not to admire the splendid fidelity with which the engineers carried themselves through the six months in which they locked horns with their employers. Of all the labor organizations in England, the best equipped for such a struggle, both in men and in money, was the Amalgamated Society of Engineers. The organization is quite the aristocracy of English trade unionism.

The machinist trade involves a high grade of intelligence, and its skilled operatives earn the best wages going. Their organization is one of the oldest, most compact, and best disciplined in the island. Its leaders are men of brains, discretion, and nerve. In deliberate preparation for this great contest, the organization had accumulated a maintenance fund of nearly two million dollars. They have been sustained by many evidences of popular sympathy, including generous contributions to their funds, and they have been careful to so conduct themselves as to win rather than alienate public support.

They have regarded themselves as the chosen champions of what is known as the "new unionism," and they knew that the whole status of trades-unionism in the immediate future of English industry turned upon their success or failure. It has thus been, on the part of the engineers, something in the nature of a vicarious struggle. They were giving battle for an abstract proposition, deemed by them vital to the future well-being of organized labor, not merely or chiefly their own group, but all branches of organized labor in England and everywhere. However widely we may differ with these men, however impossible and impracticable we may regard their demands, we must feel a genuine admiration for the grit and doggedness with which they have carried on a battle which for many months past has been seen to be hopeless. If they have failed, and failed disastrously, it is only fair to say for them that they have failed through no lack of courage or endurance.

On the other hand, let us look at the attitude of the employers, and the reasons which underlie it. From their point of view it was a struggle for existence, for the right to continue the industries in which their fortunes and future are embarked. To fully understand this it is necessary to explain the ostensible and the real reasons of the lockout. It was precipitated on July 24th last, by the formal demand of the London branch of the engineers for the eight-hour day. This demand was the logical aftermath of the successful strike of the engineers for the nine-hour day back in 1870; the Amalgamated Association having been successful in that movement, it was the natural agency through which the eight-hour movement, upon which English trades-unionism has now resolved, should be pushed to an issue. The original demand for eight hours was confined to the London shops in accordance with the well-known trade-unionist plan of campaign. The iron masters of the provinces, realizing that the success of the movement in London must inevitably extend the eight-hour day to all the iron establishments of the kingdom, made common cause, and combined to lock out their employees pending the settlement of the London difficulty. The collision being inevitable, they determined to force into it certain other ques-

tions, which the engineers had shrewdly kept in the background, but which were latent in the eight-hour movement, and, from the employers' point of view, inseparable from it—questions which have long been irritating, and the conflict over which could not long be postponed.

In the judgment of the iron masters these questions were lifted far above the range of a mere labor dispute, and involved the broad and national question of the continuance of Great Britain in the race of international competition. We need not enlarge upon the reasons which convince so many Englishmen, and particularly those who are in the thick of the fight, that England's industries and commerce, not merely foreign but domestic, are seriously threatened by the competition of the continental manufacturers, as well as those of the United States. They cite the longer hours, the lower pay, and the superior technical education of continental workmen as three reasons why the products of the latter are gradually superseding goods of English origin in the world's neutral markets. They cite the larger product from improved machinery, and the superior application of this machinery, both on the continent and in the United States, as constituting economic advantages against which they are no longer able to successfully contend. They urge that in the long run these superior advantages mean the gradual surrender of Great Britain before a competition ever closer and fiercer, in which a fraction of difference in the cost of production is sufficient to turn the scale. From their point of view the introduction of the eight-hour day, as against ten and even twelve hours on the continent, would mean industrial *hari-kari*.

But the complaint reaches further: it insists that English trades-unionism, as developed in the iron trade particularly, is a handicap to industrial progress which is bearing fruit in the continual loss of trade, and the extinction of profits in the conduct of business. Trades-unionism has aimed steadily and successfully at a larger and closer control over the conditions under which work is done in the shops. The masters had lost control over the management of their own business, and, no longer able to adapt themselves to modern methods and economics, they found themselves in a state of dry rot, extrication from which was only possible by heroic measures.

Doubtless there is a degree of exaggeration in this picture, as drawn by the iron masters. Nevertheless, it is true that English trades-unionism has become so strongly organized and intrenched, and has followed lines of policy so aggressive and so potent, that it has long been an open question in England whether the internal management of the shop is not more under the domination of the union than of the employers. Until a comparatively recent date the conse-

quences of such a situation have not been strikingly apparent. But the mechanical advances in all branches of iron manufacture during the last few years have been marvelous, and the consequent economies equally marvelous. The trades-unionists have carried on a silent, secret, and to a large degree a successful movement against the efficient introduction of these new methods in the shops under their control. There is no good reason to doubt the statement, repeatedly made by the iron masters, that Great Britain is, in consequence, far behind the competing nations in many forms of iron manufacture, in efficiency of equipment, and in product per man.

So far as this fact is due to English trades-unionism, it must be regarded as a triumph for that organization; and it is somewhat difficult to get at the philosophy by which organized labor justifies itself in standing athwart the pathway of mechanical progress. At its basis undoubtedly lies the inherited antipathy of the English workingman to labor-saving machinery. He possesses this antipathy to a degree and extent unknown in any other country. It has come down to him through the generations, and its tenacity is one of many evidences of the narrowing influence of insular conditions. The time has long since passed when this antipathy takes on the form of open violence, the smashing of machines, the burning of mills, and the maltreatment of inventors—things common enough in the days of the Luddites, seventy-five years ago. The modern manifestation of this inborn and inherited antipathy to labor-saving machinery is a species of moral boycott—indefinite, intangible, indirect, felt rather than seen. It frequently takes the form of union regulations, under which the mechanic restrains himself from turning out more than a given product in a day, irrespective of the possibilities of the improved machine he operates. The engineers' strike has inspired a great mass of literature showing how the enforcement of these regulations has tended to limit output, and thus handicap English manufacturers in their struggle against foreign competitors. Here is one of many illustrations given by Colonel Dyer, the chairman of the Federated Employers, in a recent magazine article:

> We have a very large boring machine at Elswick; this boring machine is eighty feet long. We do very rough work on it—i. e., we take the center out of the shaft by means of a trepanning tool. We took the center out of a shaft the other day seventy feet long. The whole center was trepanned out. We selected a man for working the machine; a man came round, a very intelligent-looking man, and that was all we had to judge by—we can not ask him what society he belongs to. We asked him if he could work this machine. He said of course he could. We put him on the machine, and he worked it about six or seven months. *We could never get more than four or five inches an hour out of the machine.* We pressed him,

and begged him to do better; we were very busy at the time, but we could never get above four. At last we could go on no longer; we knew that the machine should do more, and we said the machine was not giving satisfaction, and he was discharged. We then selected a boy, a very intelligent-looking young fellow, but he knew absolutely nothing about machines. We said, "Will you learn this machine?" He said he was most anxious to do so. He buckled to, and the lad in three weeks had *increased the production of the machine up to six inches an hour, and the other day I got a note that the machine was doing eleven inches an hour.*

Hiram S. Maxim, the great gun maker, who has had experience in manufacturing in three countries, declares that a given amount of labor in the iron trade produces a smaller product in England than in France, Germany, or the United States; and that a given machine has a greater productive capacity in each of these countries, and particularly in the United States, where the system of payment by the piece generally exists. The Amalgamated Society has generally successfully resisted the piece-payment system, and has managed in many other ways to practically control the internal management of the shop.

In a word, the purpose of the manufacturers has been to so change the basis of their industry that they can increase production by reducing costs, not through reduced wages, but through the more complete utilization of modern mechanical inventions. They have insisted that the individual workman would, in consequence, earn much higher wages. The movement on the part of their employees was one to limit production by the shorter working day and by the increased cost of increased overtime work at overtime wages. The ends aimed at were diametrically opposite, and the intensity and the prolongation of the struggle are thus explained. It was an issue which admitted of no compromise. A truce might, indeed, have been patched up, and the battle declared a draw; but any conclusion short of the complete surrender of one side or the other would have left the vital issue as unsettled as at the start.

As that issue has been stated, the impartial student finds it difficult to understand why it should exist at all. If the iron masters are right in their contention that reduced costs of production, through greater machinery efficiency, are necessary for the preservation of English manufacturing against foreign encroachment, the welfare of their workmen is as vitally involved as their own. This is only another way of stating the time-worn truism that the interests of capital and labor are identical, in any true analysis of their relationship.

But the English trades-unionist does not see the matter in any such light; nor is his point of view at all obscured. Apart from the latent antipathy to labor-saving machinery, which is not avowed, is

the dominant idea, strongly accentuated in all unionist literature, that there is a given amount of work to be done in this world, and not enough to go around; that the unionist, by arbitrarily limiting individual output, can thereby increase the demand for labor, and thus increase the number and the wages of the employed. This postulate of trades-unionism is as old as trades-unionism itself. It has a basis in humanitarianism which renders it praiseworthy as an abstract proposition. But it is an abstraction which belongs to the past century; which had its origin in the days when England held undisputed supremacy in the industrial world, and no combination of events seemed likely to dislodge her from that vantage. It has become an anachronism, just as England's supremacy has become a myth; and the same causes have produced the two results. If the commercial isolation of nations which formerly existed continued, the postulate of the engineers would be understandable. If English workmen still made machines for all the world, these hard-headed workmen might well have staked their all upon such an issue with hopeful hearts. But the direct results of their six months' idleness help to illustrate how far beyond their position the world has moved. The suspension of work has been an enormously expensive affair, not merely to the masters and the men, but to the nation. A great hole has been made in British commerce, and it will never be filled. Orders for machinery which the idle works in England could not fill have gone to the continent, and in many instances have come to the United States. The work has been done as well as in England; in most instances it has been done cheaper than England could have done it. The trade thus lost has gone for good. The engineers have not merely lost six months' wages; they have seriously crippled the wage-paying power of their industry. From their own standpoint, instead of increasing the opportunities for labor in England, they have reduced them. The abstract thing they fought for they have lost; but their ultimate loss would have been even greater had they won their battle instead of losing it.

The difficulty with the English trades-unionist view, then, is the failure to realize that the march of civilization has made the labor question an international question. Their contest was not so much with their employers as with their fellow-laborers in other lands. It is the competition of the latter which makes it impossible for the English iron masters to grant the eight-hour day, or to drag behind the rest of the world in the application of labor-saving machinery.

One writer, commenting upon the outcome of this strike, declares that trades-unionism has lost by its defeat all that it has gained by fifty years of constant contest. On the contrary, it would seem possible that it may gain, by reason of its defeat, a clearer con-

ception of the real forces against which labor has to contend, in the realignment of industrial conditions. If this shall come, the gain will be greater than the loss. At the bottom of the engineers' movement was a remarkable misreading of the operation of economic cause and effect. The labor question of to-day is not the labor question of fifty years ago; it turns now on broader considerations than those which local environment can control. It is no longer a question that has chiefly to do with the relative share of the proceeds of industry which shall go to labor and to capital. In the preliminary stages of the evolution which has brought the factory system to its present perfection, this was practically the only question which underlaid the strike; and it may safely be conceded that in many instances of conflict which arose over this question the strikers were right, even when they failed. The law of industrial competition under which this evolution has progressed has so operated that profits have decreased as wages have increased; and so rapid has been the evolution, so strenuous has become the competition which the increase of capital has brought about in all industries and in all manufacturing nations, and more particularly in England, that the point is already reached where the problem has come to be largely one of how to keep the earnings of capital and the earnings of labor in that status of equilibrium which shall be equitable to both. It is a development in industry which was not dreamed of when trades-unionism was getting under way; a development the end of which no man can to-day foresee; a development which has brought about an increase in the producing capacity of the world which has far outstripped the increase in population, and with which consumption can keep abreast only in spasms and by jerks. Under these new conditions, wherever and whenever an oligarchy of labor succeeds in so fortifying itself that it can establish terms under which it is no longer possible for the capital employing it to earn a fair return, then it will have killed the goose which lays the golden egg.

The English engineers resolutely shut their eyes to this aspect of the case. From their point of view it had nothing to do with the controversy. From the masters' point of view it was all there was of the controversy. To the masters it was purely an economic question; to the engineers it was one which vitally involved the social advance of the wage-earning classes. It is not necessary to believe that this social advance and economics are hopelesssly at variance in the present stage of industrialism. It is better to say that while employers have much to learn from the humanitarian point of view, trades-unionism is equally in need of instruction from the economic point of view.

Does this great strike throw any new light upon the possible solu-

tion of such troubles for the future? Unfortunately, the method of settlement of labor disputes by arbitration has not gained prestige from the experience, but has rather lost it. Arbitration was never more advantageously introduced than when the initiative was taken in the engineers' strike last November by the Right Hon. T. C. Ritchie, president of the Board of Trade, and one of the most influential members of the Salisbury Cabinet. It was left for him to arrange the "*pour parlers*" of the conference, and the moral influence outside the committee room for a settlement was tremendous. The only result was to strengthen the position of the engineers, for they shrewdly consented to submit to their union certain propositions made by the employers, and they were rewarded by a vote of forty thousand in opposition, with only one hundred and fifty in favor of acceptance. If this had been purely a question of wages, arbitration would have doubtless settled it. Wages involve questions of fact, and conference and discussion are increasingly successful in bringing employers and employed together on a basis which knowledge of the facts shows to be mutually equitable. But bound up in this controversy was the whole question of the economic conditions of modern industrialism, both national and international, as well as the question of that indefinite, indefinable line where the rights of the employer end and those of his workmen begin. The more the conference discussed these questions, the farther apart the parties to it found themselves. They are beyond settlement, except a temporary armistice, by any scheme of arbitration under any auspices, private or governmental. There is no middle ground, in such a dispute as this one was.

But time and the sequence of events will work out a solution, as has been the case with all the great problems which have successively confronted civilization. We can not see into the future, nor can we even vaguely outline the ground upon which employer and employed will ultimately agree to live at peace with each other. But we need not despair of its finding, nor need we fear that it is hopelessly distant. The world moves faster in a modern decade than in three centuries of the middle ages. A hundred years ago the world did not dream of such a thing as the labor question in the form in which it now presents itself. This present phase is only a transitional episode of conditions quickly developed, but not yet sufficiently advanced to have worked themselves into their final forms. Every great controversy like the engineers' strike throws a flood of light upon the problem by bringing all its elements into clearer relationship, and unconsciously leads the world a step nearer to the ultimate solution. An all-sufficient reason for this hopeful view of the matter is the fact that larger knowledge is always coming to

those who are parties to these controversies. It is impossible to doubt that the wide diffusion of education is always helping to clarify the situation. It has done much already to relieve the industrial strike of its uglier features. Riot and bloodshed now rarely mark it where the parties to a contest are men of average intelligence and education, like the English engineers. So the evolution will advance, step by step, and point by point, until the time shall come when exact justice to all concerned, in harmonious accord with the economic laws of modern business, shall have worked itself out.

THE ELECTRIC TRANSMISSION OF WATER POWER.*

By WILLIAM BAXTER, Jr.

EVER since the electric light and power industry began to be a factor in the economic affairs of the industrial world, its adaptation to the work of transmitting the power of waterfalls to more or less distant points has been the dream of those who realize its vast possibilities, and who believe that the ingenuity of man is equal to the task of overcoming any difficulties that may be encountered in attempts to find a successful solution of the problem. For more than twenty years those who may be called electrical enthusiasts have prophesied that the day would come when the power of Niagara would be delivered at the door of the consumer in the city of New York, and capitalists have not been lacking who would have provided the means for carrying out an undertaking of this kind if they had been given the proper assurance by electrical engineers of prominence that the results sought for could be attained. Such assurance, however, could not be given; for, although it is known that there is no difficulty in the way of accomplishing such a result theoretically, the practical development of the art has not reached a stage that would render the realization of such an undertaking possible.

To transmit power by means of electric currents over long distances, without suffering too great a loss in overcoming the resistance of the conducting wires, it is necessary to make use of a high electrical pressure, the effect of which is to render very difficult the perfect insulation of the line, so as to prevent the escape of the current. The greater the distance to which the current is transmitted, the greater must the pressure be to keep the loss of energy and the cost of wire within permissible limits; hence, when the pressure

* For the illustrations in this article we are indebted to the kindness of the General Electric Company.

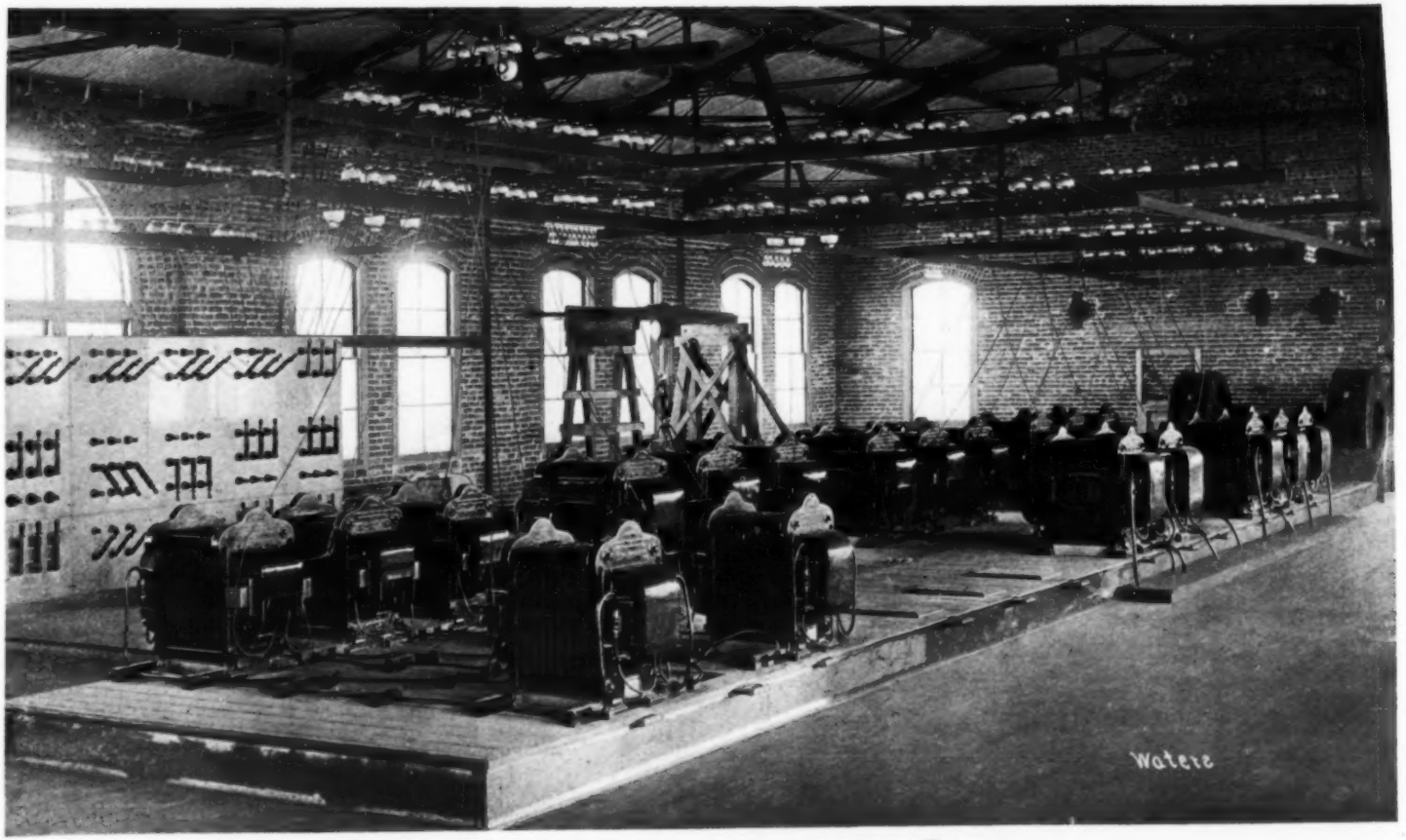
Loom Room, Ponemah Mills, Taftville, Conn.

required becomes as great as can be insulated with certainty in the present state of the art, the distance of transmission is increased to the utmost limits attainable in practice. Until some more perfect means for confining the current is devised, greater results can not be reached. With our present knowledge of insulating materials, and our methods of applying them, it would be practically impossible to transmit energy over distances as great as from New York to Niagara, but it does not follow that the accomplishment of this result will never be witnessed; it is a possibility of the future, that may not come for a century or more, or may be realized within the next few years.

Although the achievement of such stupendous results as the transmission of power over several hundred miles is not within our present reach, it is possible to bridge distances of twenty or thirty miles, and the accomplishment of this much has been considered entirely practicable for several years. It was on this account that the Niagara power plant was started, the object being to supply the city of Buffalo and other places within a radius of twenty-five or thirty miles. This undertaking, owing to the magnitude of the power available, has attracted world-wide attention, and is probably regarded by the vast majority of people as the only work of any importance in this line that has been attempted. This, however, is far from being true; it is the largest, and will undoubtedly always remain such, since the source of energy is practically unlimited, but there are several other very large installations, and in some of these the distance of transmission from a mile or so up to thirty-five miles. place being nearly double that distance.

A fair idea of the extent to which this branch of the electrical industry has been developed may be gained from a consideration of the fact that one manufacturing concern alone has sold over two hundred thousand horse power of machinery for this purpose within the last four or five years, their sales for 1896 being over seventy-five thousand horse power. The great increase in the business during the past year, in the face of a general stagnation in all other lines of industry, is a very clear indication that what has been done in the past has been entirely successful—so much so as to inspire an amount of confidence sufficient to overcome the apathy or unwillingness to embark in new undertakings so manifest in all other lines of business.

The total number of water-power transmission plants in successful operation in the United States in addition to the Niagara installation is over two hundred. The amount of power transmitted ranges from less than one hundred horse power up to twelve thousand, and the distance of transmission from a mile or so up to thirty-five miles.



STEP-DOWN TRANSFORMERS IN SUBSTATION. FOLSOM-SACRAMENTO TRANSMISSION.

To give an idea of how near to New York city work of this kind is being done, we may mention a few installations.

There is one at Springfield, Massachusetts, where about nine hundred horse power is transmitted to a distance of over six and a half miles; one at Bondsville, Massachusetts, having a capacity of about thirteen hundred horse power; and another at Fitchburg, Massachusetts, of about four hundred horse power. In this latter plant the distance of transmission is only two and a half miles, but as an offset to it, in distance as well as amount of power, may be mentioned a plant in Quebec, Canada, where over two thousand horse power is transmitted eight miles. At Concord, New Hampshire, there is an installation of several thousand horse power capacity, which is transmitted to a distance of five miles.

At Hartford, Connecticut, there is a plant of about fifteen hundred horse power, which is transmitted a distance of eleven miles; at Baltic, Connecticut, about fourteen hundred horse power, and in several places in the New England States, installations ranging from two hundred to one thousand horse power can be found. At Hookset, New Hampshire, there is a plant of three thousand horse power, which is transmitted about eleven miles. In the State of New York there are plants at Gouverneur, Canandaigua, Tonawanda, and many other places.

The plant at Baltic, Connecticut, furnishes power to operate one of the Ponemah mills at Taftville, about four miles and a half distant. The interior of this mill is shown in the illustration on page 731. In addition to operating this mill it furnishes power to run the Norwich street railway.

The Ponemah mills, two in number, were originally operated by three turbine wheels and two steam engines, the water power not being sufficient at all times of the year to meet the requirements. In 1892 the Norwich Street Railway Company was changed from horse to electric, and made a contract with the Ponemah Company to furnish the power. The road, which started in a small way, soon increased, and the extra load proved too much for the three turbines and the two engines, located at the mills, to carry. It was then decided to develop and utilize the water-power privileges owned by the Ponemah Company some distance up the Shetucket River, and transmit it by means of electricity to the mills and the railway. The old dam was enlarged, and three turbine wheels, having a combined capacity of nearly two thousand horse power, were installed. These are belted to a line shaft from which the electric generators are driven. At the end of the line the current is used to operate one of the mills, to furnish the necessary light, and to operate the railway already referred to, and, in addition to this, two locomotives used to

haul freight, one being of five hundred horse power and weighing thirty tons.

The current generated at the power station is of the alternating type, and undergoes one or two transformations before being used at its destination, but the operation of the apparatus is so perfect that this power, generated four and a half miles distant, can be used in connection with the steam engines at the mills, and each one will do its proper share of the work.

A plant of twelve thousand horse power is now being built at the Lachine Rapids, about five miles from Montreal, Canada, and, although it is not larger than some of those in operation, or in process of construction in the western part of the country, it may in time become such, as the source of power is very great, and increases can be made as fast as the demand calls for them. At Trenton, Canada, there is a plant of about nine hundred horse power which is transmitted a distance of twelve miles.

Within the past few months it has been found by the investigations of engineers that a very large power can be obtained near the town of Massena, in the State of New York. At this point the St. Lawrence River descends about one hundred feet in a few miles, going over the Long Sault Rapids; but the Grass River, which runs nearly parallel with it and only about three miles distant, drops but fifty feet. As a result of this difference in the fall of the two rivers, the St. Lawrence is fifty feet higher at the head of the rapids than the Grass. By cutting a canal of sufficient size at this point the water of the St. Lawrence can be diverted to the Grass and over the fifty-foot fall, thus developing an amount of power limited only by the size of the canal. The estimates of the engineers who have surveyed the site is that as much as two hundred thousand horse power can be obtained. The work of development is under way, and if it is carried through on the scale proposed will only be surpassed in magnitude by the Niagara plant.

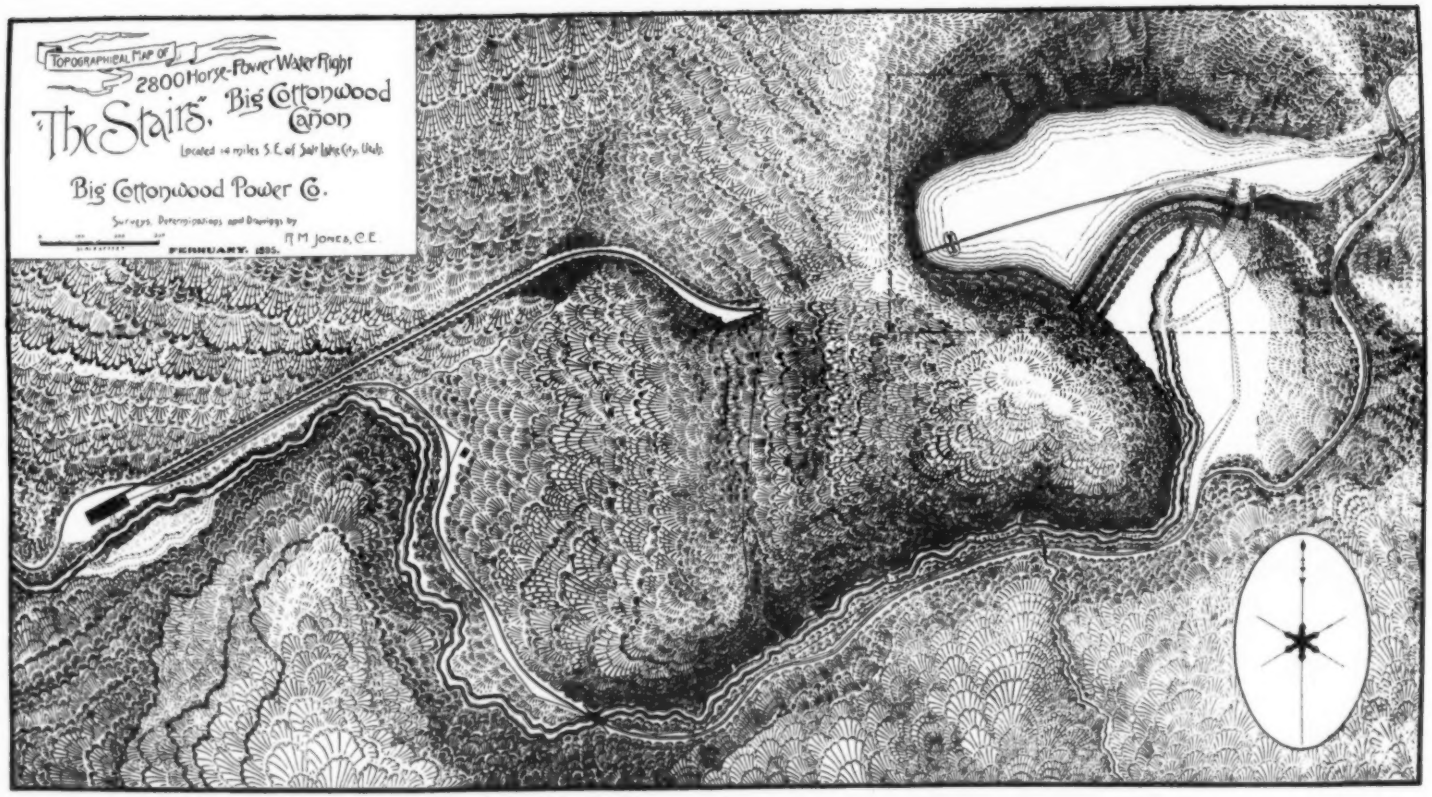
The largest water-power transmission in the South is probably one located at Pelzer, North Carolina. At this place nearly four thousand horse power is utilized, and transmitted a distance of about three miles, where it is used for the operation of extensive cotton mills.

There are many transmission plants in different parts of the West, the largest of which is, perhaps, at Minneapolis, where the amount of power utilized is over ten thousand horse power; but none of these is of as much interest as those to be found on the Pacific slope, owing to the fact that with few exceptions the distance of transmission is short. In the latter section, however, the possibility of using electric transmission for great distances is better demon-

strated than anywhere else. At Redlands, California, there is a plant that delivers the power at a distance of over twenty miles. At Fresno, California, over two thousand horse power is transmitted about thirty-five miles. A noticeable feature of this last-named installation is the enormous height of the water fall. The head is fourteen hundred and ten feet, which is the greatest in use, commercially, in any part of the world. What such a head really means can be realized when we state that the pressure of the water amounts to over six hundred pounds to the square inch. The distance of transmission, thirty-five miles, is also the longest now in actual use, but it is less than that of the Pioneer Electric Company of Ogden, Utah, which is in process of construction. The work now under way at this latter place will transmit power to Salt Lake City, a distance of thirty-six miles, but it is intended to carry the line to mines thirty miles beyond this point; therefore, when the whole system is completed, the total distance of transmission will be sixty-six miles.

The Folsom-Sacramento power-transmission plant is one of the most noteworthy of those so far installed, as it serves to show clearly the great benefits derivable from the use of electricity. The power station is located at Folsom, on the American River, where one of the largest water powers in the State of California is available. The first attempt to utilize this power was made as far back as 1866, but owing to the conditions then existing was necessarily limited in its capacity to the demands of the immediate vicinity. The work as at first conceived embraced a dam across the river, the water to be used in part for power and in part for irrigation purposes. The plan was modest in its proportions, and remained so for many years; but the development of electric transmission has magnified it into an undertaking of vast magnitude, embracing the development and transmission of over five thousand horse power when the full capacity is reached. The dam now used is six hundred and fifty feet long and eighty-nine feet high, and has a storage capacity of about thirteen million cubic yards. The water is conveyed to the water wheels by canals two miles long and fifty feet wide by eight feet deep.

The power station in which the wtaer wheels and the electric generators are located is so designed that the latter are connected direct with the former, being mounted upon the same shafts, but separated from each other by a stone wall, through which the shafts pass. The electric current developed in this station is transmitted to Sacramento, a distance of about twenty-five miles, and is there received in a substation, the interior of which is shown on page 733. The current coming into this station from the power plant is of a very high pressure, entirely too high for commercial use, and there-


Topographical Map of
2800 Horse-Power Water Right
"The Stairs," Big Cottonwood Canon
Located 14 miles S.E. of Salt Lake City, Utah.
Big Cottonwood Power Co.
Surveys, Determinations and Drawings by
M M Jones, C.E.
FEBRUARY, 1895.

fore has to be reduced by being passed through the machines shown in the illustration, which are called step-down transformers, their office being to reduce the pressure of the current. These transformers in reality do not reduce the pressure of the current; what they do is to generate a second current, by the aid of the energy derived from the first, of a much lower pressure. The power of the substation is to be used for all purposes, for "arc" and incandescent lighting, for driving stationary motors, and for the operation of electric railways.

The Big Cottonwood Power Company has about completed the construction of an important plant to utilize the water power of the lakes in the Wahsatch Mountains, and distribute it in and around the vicinity of Salt Lake City. These lakes, which empty into the Big Cottonwood Cañon, lie at elevations above the sea ranging between eleven thousand and thirteen thousand feet; therefore the total amount of power available is very large on account of the enormous fall. The Big Cottonwood Company controls a fall of about one thousand feet, but in the present installation will only use about four hundred feet. The water is confined in a reservoir, as shown in the topographical map on page 737, and is conveyed by pipe line to the power house, as is shown quite clearly in the illustration of the site of the latter on page 739, where the pipe is seen in the background, descending between the mountains. To guard against an accidental giving way of the reservoir, as well as to render it possible to empty it when desired without interfering with the operation of the plant, the pipe line is carried along the bottom to the upper end of the reservoir, where it connects with the main source of supply. By closing one gate and opening another, the water may be drawn from either point, as occasion may require.

The capacity of this plant is about twenty-five hundred horse power, which will be distributed at a distance of about fourteen miles. The water wheels are mounted directly upon the shafts of the electric generators, as can be seen from the illustration of the interior of the power station shown on page 741. The generator in the foreground is not provided with a water wheel; the only part of this apparatus visible is the water pipe under the shaft, between the two bearings. This generator was not completely mounted when the photograph was taken, but the two machines in the background, it will be noticed, are provided with water wheels, which are mounted on the shaft in the space between the two bearings, which in the front generator is uncovered. The simplicity and solidity of this apparatus are very striking, and, being one of the latest installations, show clearly the perfection to which machinery of this class has been carried; and from the fact that the capacity of

Power House of Big Cottonwood Power Company.

each generator is about six hundred horse power, its compactness is also apparent.

There are any number of other power-transmission plants in this country, a description of which would prove interesting not only on account of their magnitude, or the distance to which the power is conveyed, but also on account of their revealing the vast amount of engineering skill displayed in surmounting difficulties that have been contended with; but the examples described in the foregoing are sufficient to show the enormous strides that are being made in this field, and yet the general public is almost wholly unaware that anything is being done except in an experimental way.

The electric transmission of power is not confined to this country by any means; plants of very large proportions can be found in almost every quarter of the civilized world, and in some places not specially noted for their civilization. In Mexico there are several installations, and no doubt there would be more if it were not for the fact that there is a scarcity of large streams and rivers in that country; therefore, although its mountainous conformation would lead to the conclusion that waterfalls are numerous, as a matter of fact those where the power available is sufficient to warrant its utilization are very few.

The principal installation in Mexico is at Pachuca, one of the most important mining districts in the country. The power plant is located at Regla, which is about twenty-three miles distant. The capacity of the plant is over three thousand horse power.

There are several plants in South American countries, quite a number in Africa, in Australia, in Asiatic countries, and also in Europe. The Jungfrau Mountain Railroad in Switzerland, which has been called the trolley to heaven, will be operated by power derived from the Black and White Lutschine Rivers, in Burglauenen and Lauterbrunnen. This road, which is about finished, ascends to one of the highest peaks of the Alps, one which heretofore has only been accessible to those of sufficiently vigorous constitutions to make the ascent on foot.

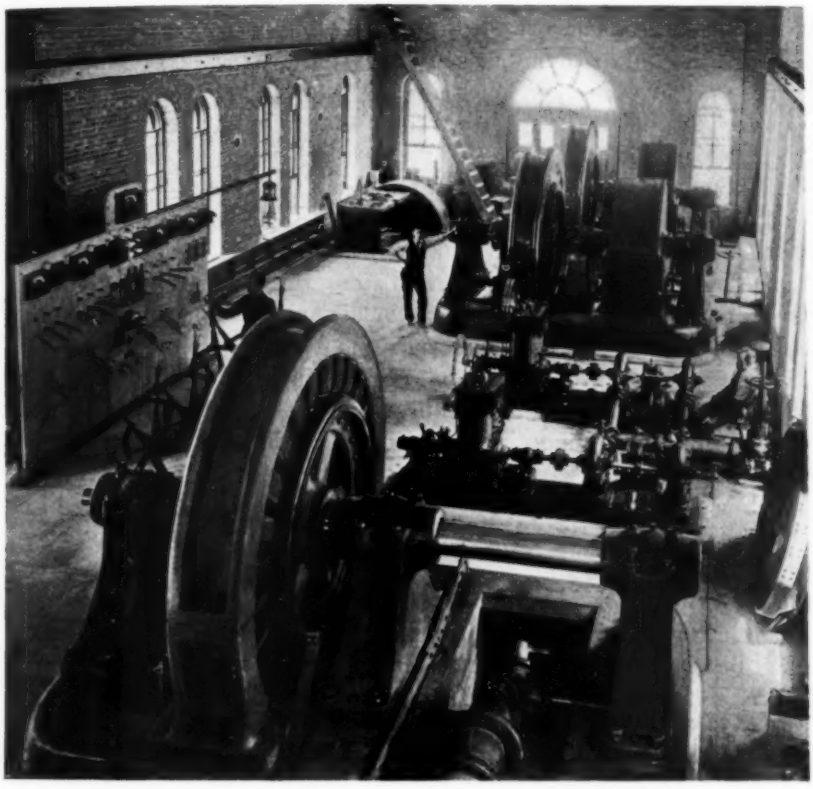
The Geneva water power is utilized to operate electric railways, electric lights, and to some extent for the development of power for industrial purposes. The distance of transmission at this place is about twenty miles.

Other installations in Europe of importance that may be mentioned are Rome, Italy—distance, about eighteen miles; amount of power, two thousand horse power, which is being increased to nine thousand; Davos, Switzerland; Schöngeisung, Germany; Lauffen to Heilbronn, Germany; Zurich, Switzerland, and many others.

The longest transmission ever undertaken was an experimental

one between Lauffen and Frankfort, during the exposition at the latter place some years ago. This distance is one hundred miles, and, although the work was experimental and only intended to show what could be done, it was entirely successful, notwithstanding that the amount of power transmitted was only three hundred horse power.

From the few examples given in the foregoing paragraphs it can be seen that the electrical transmission of water powers to points where they can be conveniently utilized has passed far beyond the



INTERIOR OF GENERATING STATION. BIG COTTONWOOD POWER COMPANY.

experimental stage, and that the business of supplying apparatus for such purposes has already assumed large proportions, with every prospect that before long it will be a very important, if not the most important, branch of the electrical industry.

A contemplation of the results that may follow development along this line must lead to the conclusion that manufacturing centers will be materially changed. In many kinds of industry power is used so extensively that its cost is an item of the greatest importance,

and concerns engaged in work of that class will in many instances find it to their interest to locate where the energy of waterfalls may be available at low rates. The successful operation of the Niagara plant has had the effect of attracting to that section of the State several enterprises that require power in large quantities, and it is more than probable that, before many years pass by, Buffalo and the surrounding country will become an important manufacturing center. What is true of this case will be equally true of many others, and, while established enterprises may not remove from their present location, those started hereafter will undoubtedly be guided by the relative cost of power at different points, in connection with the advantages and disadvantages arising from the location of the power center. Thus, as the South is the source whence all the cotton comes, it would be natural to assume that manufactories in this line would locate in that section at points where water power can be obtained convenient to the cotton fields. That such localities can be found is quite evident, since, according to the census of 1880, the power available along the Chattanooga River is not far from one hundred thousand horse power, and along the various rivers of North and South Carolina, Georgia, and Alabama three or four times this amount can be obtained. All over the West and Northwest extensive power sites are to be found, and in time many of them will be rendered useful, and will form the centers of manufacturing districts, thus gradually augmenting this line of industry in sections of the country that at present are principally agricultural.

For several years to come it is very probable that efforts will be confined to the utilization of large units, but gradually the cost of installation and of operation will be reduced, and then smaller powers will be considered profitable. Following along this course of reasoning we may naturally conclude that, eventually, even farmers may be able to render available the energy of small streams passing through their possessions, and the future rural generations may use the electric motor to do the work around the farm that at the present time is performed by animal power.

THE name America for the western continent is said to have been proposed by Martin Waldseemüller, in his Introduction to Cosmography, published in 1507; but the exact time when it first appeared in a map is not precisely known. The earliest instance so far has been discovered by Professor Elter, of Bonn, in a manuscript map by Henricus Glareanus, dated 1510, in which the legend "Terra America" is attached to South America. Glareanus, born in 1488, became German poet laureate in 1512, and a professor at Freiburg in 1529. He has left what is probably the earliest circumpolar map in existence. In his map of America, North America is separated from South by a strait, and is represented as forming part of Asia.

CRIMINAL ANTHROPOLOGY IN ITALY.

By HELEN ZIMMERN.

"Enemy" ye shall say, but not "wicked one"; "diseased one" ye shall say, but not "wretch"; "fool" ye shall say, but not "sinner."—F. NIETZSCHE.

IF we were asked to name in what particular Italy stands to-day quite head and shoulders above her fellows, we should unhesitatingly say in the science of criminal anthropology. This is an essentially Italian study, whose origin we discover as early as 1320, when the King of the Two Sicilies decreed that no one should be permitted to practice medicine who had not studied anatomy for at least one year. After this, in the fourteenth century, we find men who devoted themselves to the study of skulls, thus laying the basis of the science of craniology. It was Italians, therefore, who initiated this science, and to Italy has been reserved the proud place of bringing it to its high development in the nineteenth century, even though the discoveries of Darwin, which gave it a fresh impetus, date from England. Beyond question the peninsula is at the head and front of all studies connected with criminal anthropology, and not of criminal anthropology only, but of all cognate sciences connected with crime and the criminal.

To the Italians belongs the merit of reviving the study of a question with which philosophy, law, and medicine have always been occupied. It has been well remarked that whenever philosophical studies have free expansion, that whenever the desire to safeguard society, the spirit of toleration, the methods of ameliorating the fate of the guilty, have been studied by thinkers, their conceptions have eventually conquered public opinion. It is to the glory of Italy, the land where Roman law, the foundation of modern law, was born, that it has again put into the crucible this problem of criminality, and that it has proceeded to the study of this problem by the only truly scientific method—namely, that of studying the psychology of criminals and their pathological abnormities. It will be its distinction to have declared against illusory enthusiasms, and to have founded a science which will contribute to the more efficacious protection of society. The recognized chief of this Italian school is Prof. Cesare Lombroso, of Turin, who has illustrated his theories by a number of remarkably able and interesting books. Until quite recently, to the world at large, the criminal figured as of the Bill Sykes type—and who, reading Oliver Twist, has not shrunk with horror on perusing the intimate drama of the ruffian's mind after the brutal murder of the faithful Nancy? These things move us as the highest efforts of Dickens's imagination. Bill Sykes was written in prescientific days.

It is instructive to turn from him, and the class of melodramatic ruffians of whom he is but an example, to the criminals dispassionately laid bare in mental, moral, and physical dissection by Lombroso and his fellow-workers. Certainly no such type as Bill Sykes, a projected image of the novelist's brains, coinciding with a highly strung nervous system, is to be found in the gallery of habitual malefactors presented to us in the *Uomo Delinquente* and other books. Habitual malefactors, according to Italian students, are a class apart from other men, a distinct species of "genus *Homo sapiens*," must be judged by special standards, and must by no means be informed with the feelings of normal men. Herein consists the fundamental basis of the new science of criminal anthropology—a science which bids fair, in spite of conservative and clerical opposition and even of ignorant ridicule, to modify profoundly our present manner of considering and treating these enemies and pests of society.

"Criminal anthropology," says Signor Sergi, one of the ablest exponents of the new system, "studies the delinquent in his natural place—that is to say, in the field of biology and pathology. But it does not for that reason put him outside the society in which his criminal manifestations occur, for it considers human society as a natural biological fact, outside of which man does not and can not live. As normal anthropology, like other biological sciences, studies and observes the individual in his natural *milieu*, and finds that this *milieu* is double, physical and organic, and under this double aspect sees him develop and act, so criminal anthropology does the same with the very limited and specialized aim of discovering the nature and origin of the phenomenon of crime. Every phenomenon, however, remains inexplicable if it be examined alone; the explanation is easier if it be studied in the complex of phenomena developed in the double physical and social *milieu* of which we have spoken."

Words such as these, where we find embryology, physiology, anatomy, chemistry, and statistics, invoked as aids to the origin of crime, place us at the antipodes of ancient philosophies; yet Lombroso and his school are in reality acting on the old-world notion embodied by Horace in his "*mens sana in corpore sano*." The delinquent, they argue, acts abnormally. Acts being the visible results of functions performed by the brain and reflective nervous system, it follows that these functions are abnormal. The functions being abnormal, the organs which perform them must be either abnormal or troubled in their action by the habitual or accidental interference of disturbing causes, for no normal organ acting under normal conditions can perform abnormal functions. The founders of this new school, therefore, dedicate themselves first of all to the study of the skull, brain, and nervous system of the criminals; then

make careful observations not only on other parts of the skeleton but on the living body; the height, length, and proportion of the members, the total or partial development of each part; the weight of the body, its muscular development, the deeper-seated organs, such as the heart, liver, kidneys, intestines; the various functions which may directly or indirectly affect those of the brain, such as the circulation of the blood, digestion, and the disturbances which show themselves there, and in consequence of the general state of the organism as regards the balance of the vital functions; sleep, sexual manifestations, normal or abnormal muscular force, and other factors besides. Everything, indeed, which concerns the morphology of the criminal is passed through the sieve of the severest scrutiny. This scrutiny reveals, as might be expected, various irregularities. The skull, for instance, presents anomalies of shape and size, being in a large percentage of cases abnormally small; anomalies indicative of regression and of arrested development; anomalies in the position, shape, and closing of the sutures, "the doorways of the head" being invariably closed too early. Morphological irregularities are also found in the bones of the face, notably in those of the nose and lower jaw. The brain itself, say the investigators, shows unmistakable signs of a degraded form, in the number and distribution of the cerebral convolutions, in the entire atrophy of some parts, in the extraordinary development of others. The shape and structure of the skull and brain, says Lombroso, connect criminals very closely with primitive man, and even with his animal ancestors. Criminals must be regarded either as forms belated in the race of development, or as physical and therefore also moral degradations—unavoidable, regrettable products of our civilization. In either case they form a distinct species, in need of scientific investigation.

The action of the brain is, however, not only modified by its form and development, but also, in a very large number of cases, by pathological occurrences. Traces of old wounds, "some head-blow not heeded in his youth," said Sir Kay of King Arthur's self—hæmorrhages, affections of the investing membrane and of the blood-vessels are seldom wanting. In other words, the organ that controls and originates actions is in a morbid state. Further, the slight irregularities constantly verified in the branchings of the blood-vessels in the heart, liver, and other viscera can not but conspire, by the abnormal functionings they occasion, toward the production of physiologically irregular organisms.

Intimately connected with the physical conditions of the criminal are his psychic peculiarities. These consist chiefly in great instability of character, coupled with overwhelming development of some passion and the atrophy of some others. The criminal acts from

impulse, although he often displays, as madmen do, a low cunning in finding means to carry out his impulse. He is intensely vain, priding himself on the number of crimes he has committed. He is further devoid of all remorse, fond of boasting of his evil deeds and of describing them in detail. Thus Lombroso gives the reproduction of a photograph, in which three murderers who had assassinated one of their number caused themselves to be represented in the very act of committing their deadly deed, a photograph taken for the benefit of their less fortunate associates.

This inordinate vanity is often in itself the primary cause of terrible crimes, especially in young men who have just attained puberty, an age observed to be especially fruitful in crimes of violence. The critical character of this period, even in well-balanced minds, is abundantly known; little wonder, then, if it prove fatal to those whose constitutions urge them to extremes. It is noticed also that the criminal needs to lead a life full of noise. The necessity of orgies entailed by the irregularities of his feelings is often the moving cause of some act of violence, such as robbery and assassination, calculated to procure the means of indulgence. His affections, too, are abnormal: he will assassinate father and mother, and yet be capable of making sacrifices for some companion in time of illness. This trait, however, occurs more often among women than men. We used to believe there was a species of honor among thieves, but Lombroso asserts that it is rare to find any consistent attempt to shield each other; on the contrary, the almost physical need they feel of talking incessantly renders them specially inclined to mutual betrayal. The criminal is fond of tattooing himself, and so distinctive a mark of criminal tendencies is this held in Italy that tattooed recruits are looked on as likely to make bad soldiers; and a private once spoke to Lombroso of tattooing as "convict habits." He presents, too, an extraordinary insensibility to pain, tattooing himself in places which even the Indians spare, and receiving or inflicting on himself the most terrible wounds without a murmur.

He has a language of his own, employed even in cases where he would run no risk from using ordinary speech, and this still further isolates him from the rest of mankind. He has a writing of his own, too, made up of hieroglyphics and rough pictures.

Such briefly is the Frankenstein, which the modern science of criminal anthropology evokes; an unbalanced being, a pathological subject, whose illness takes a form which, hurtful to society, is defined as crime. For the facts collected by Lombroso place beyond all doubt the intimate connection between crime and mental derangements which has so long been suspected to exist. Madmen and criminals belong to the same family; not in the sense of the vulgar

and unthinking expression that all criminals are mad, though every-day experience in the police courts puts it beyond doubt that many are actually deranged, but in the sense that both classes are in a similar pathological state, which manifests itself on the one hand in lunacy, on the other in crime. This position is rendered still stronger by the revelations of genealogical statistics, which reveal the heredity through long generations of criminal tendencies, as they do of insanity, and alternations of criminals and madmen, in the same or successive generations.

Lombroso divides criminals into two great classes, the original or born delinquent, and the fortuitous offender, a man who becomes criminal through outward influences.

The first, the synthesis of every degeneration, the outcome of all biological deterioration, commits crimes against society by virtue of a morbid process passing from one generation to another, derived from cerebral and other physiological conditions. In him the impulse of passion is not sullen or isolated, but associates itself almost always with reflection. The second, on the contrary, the criminal of passion and impetus, acts at a given moment in consequence of an overwhelming stimulus, say a sudden access of jealousy. The two classes frequently merge into each other, for the mere fact that a man, suddenly, without reflection, by a reflex act, as it were, stabs his offender or his unfaithful wife, proves that he is not normal. The want of reflection constitutes an extenuating circumstance before judge or jury, but before pathological psychology, says Signor Sergi, "it constitutes an accusation."

The importance of the distinction is seen in the views taken on criminal jurisprudence by Lombroso and his school. It is generally said that to act logically in face of these views we should have to make extensive use of capital punishment. The most hasty perusal of Lombroso's books will show that this is not his view of the case. He lays immense stress on prevention, for even the morbid process may, he asserts, be modified in the very young, just as a disease, taken in time, may be cured, but, neglected, becomes chronic.

He examines carefully the means adopted in various countries for refining the minds of children, and speaks warmly of English ragged schools. Juvenile refinement, strict but judicious control, education in the highest sense of the word—these must be, he argues, the primary object of every nation which aims at decreasing its criminality. He also advocates an association between various nations for the hunting of criminals, and for making such observations on their lives and habits as shall lead to their easier classification. In reformatories he has small belief; statistics show that they in no way decrease the percentage of recidivists; the fact of recidivism shows

the habitual criminal, and here no punishment will suffice. The man must be treated as though afflicted with a serious illness and removed from society, for which, however, he may and should be made to work. He insists that these questions are of vital importance to every nation, and asserts repeatedly that teachers in ragged schools and founders of polytechnics are patriots and philanthropists in the highest sense of the words, because helping to stamp out crime more than all the long-term sentences in the world. Crime is at once a biological and a social phenomenon. The criminal is a microbe which only flourishes on suitable soil. Without doubt it is the environment which makes the criminal, but, like the cultivation medium, without the microbe it is powerless to germinate the crime. To use Professor Ferri's expression, up to recent times the criminal has been regarded as a sort of algebraic formula; the punishment has been proportioned not to the criminal but to the crime. Anthropologists are teaching us to strive after scientific justice. Time and events have brought into clear relief the inadequacy of legal maxims, founded on antiquated and unscientific conceptions, and thus modern Italians show us that not the nature of the crime but the dangerousness of the offender constitutes the only reasonable legal criterion to guide the inevitable social reaction against the criminal. This position is the legitimate outcome of the scientific study of the criminal. And where the man of science has led the way the man of law must follow.

ENRICO FERRI.

Such, in brief and somewhat in the rough, are the conclusions of Italian criminal anthropology, which we have given at some length, as the subject is too vast as well as too new to be clearly comprehensible in a few words. In the autumn of 1896 an International Congress of Criminal Anthropologists was held at Geneva, and on this occasion the Italian school triumphed as never before over all adversaries and schismatics, and especially over their French col-

leagues, who have carried their antagonism to Italy and things Italian even to the serene fields of science. The French objections were beaten down by a very hailstorm of facts, so carefully collated, so industriously collected, that opposition was perforce silenced. In the front ranks of the combatants, indeed, leading the attack, was that eminent criminal sociologist, Enrico Ferri, whose legal vocations have not hindered him from continuing his favorite studies, though he is no less valiant as a lawyer than as a scientist. Indeed, he holds that the two studies ought to go hand in hand. All lawyers, he affirms, should dedicate themselves to the study of criminal anthropology if they would go to the fountain-head of human responsibility; all judges should be inspired by this doctrine, ere blindly punishing a culprit on the faith of a code not always founded on direct observation of the environment or of the individual. "It is not true that with Lombroso's theories all prison doors would be broken down and respectable humanity given over to the mercy of delinquents, as our opponents say. And were the first part of this strange paradox to be verified—i. e., that which demands that in order to be logical all prison doors be opened — there would open also those of the lunatic asylums in order to permit the entry of the men ejected from the prisons, individuals whose mental and physical constitutions pushed them into crime." It was just this theory of the *born* criminal, which Lombroso was the first irrefutably to prove, and whose effects must shortly be felt in criminal legislation, that carried off the most clamorous victory at Geneva.

CESARE LOMBROSO.

Cesare Lombroso, who is a Hebrew by birth, was born at Turin, in 1836. As a mere lad he loved to write, and composed, with the same facility and rapidity that distinguishes him to this day, novels, poems, tragedies, treatises on archæological, physiological, and already on sociological subjects, those dating from his student days being actually published, so much talent did they show. Medicine

was the study to which he devoted himself, and his first independent researches were directed to examining into the causes that produce the idiotism and the pellagra that exist, unfortunately, so largely in Lombardy and Liguria. His treatise on this theme attracted the attention of no less a person than Professor Virchow. After fighting for the independence of Italy in 1859, he was appointed professor of psychiatry at Pavia, where he founded a pyschiatric museum. From Pavia he passed to Pesaro, as director of the Government madhouse, and thence to Turin as professor of forensic medicine, a position he still retains. It was in his native Turin that he began those original studies destined to make his name famous over all the globe. Endowed by nature with a strong intelligence, a robust will, and a keen intellectual curiosity, he was indifferent to the incredulous smile, the sarcasms, that greeted his first efforts at solving problems hitherto held insoluble. Very bitter, very hard were his struggles—how hard only those can appreciate who have talked with Lombroso in intimacy and have noted the pained scorn with which he speaks of his adversaries—adversaries some of whom are not silenced to this hour. But his science, his studies conquered, which if not always complete yet are always serious, wherefore criminal anthropology, a mere infant some thirty years ago, may to-day be said to be adult; a raw empiric but a while ago, to-day a science, young if you will, but vital and destined to overturn the facile, fantastic monuments erected by so many penalists. The work with which Lombroso will go down to posterity is a huge book, huge in every sense of the word, in which criminal man is studied on a scientific basis. We refer to the *Uomo Delinquente*, of which its author has published most recently a new, revised, and enlarged edition, wrestling with new facts, new observations, and new deductions. This edition is limited to one hundred copies, perhaps to allow its prolific author soon to issue another, enriched with yet more facts, yet more acute deductions.

It is dedicated to Max Nordau, the author of that noted book, Degeneration, who had in his turn dedicated his work to his master, Cesare Lombroso. The dedication reads thus: "To you I have wished to dedicate this volume with which I close my studies on human degeneration, as to the most sincere friend I have found in the sad course of my scientific life, and as to the one who has wrested fecund fruits from the new doctrines I have attempted to introduce into the scientific world." Needless to say that Lombroso is the very first person to admit that in the almost virgin field of criminal anthropology there is still much to do, and that Science has not yet spoken her last word; but it is his magic wand that has indicated the horizon and has swept over vast new areas, often with

lightning rapidity and intuition. Thus the base of the new edifice was laid, and the rest of the new monument rose up rapidly around it, notwithstanding its occasional faultiness, pointed out eagerly by adverse scientists, criticisms that could not shake down the edifice, for its base was too solid and strong. Gradually a few apostles of the new science gathered around Lombroso, and although Morselli, one of the most acute and cultured observers, after a time severed himself from the group and joined the French schismatics, nevertheless the little compact mass moved from success to success, from triumph to triumph, up to the late ultimate triumph at Geneva.

Another of Lombroso's books which aroused much discussion and which may almost be said to have founded yet another school, if we may so designate the group devoted to the study of another branch of anthropology, was *Genio o Follia*, which largely helped to make its author's name known even outside of strictly scientific circles. This work enchanted all thinkers, psychiatrists, doctors, indeed, all men who dedicate themselves to the search for signs of madness in the lives and works of eminent authors and artists. For Lombroso had striven in this book to prove scientifically how closely genius and madness are allied. As was the case with Criminal Man, so here too the master's disciples strayed from the paths laid down by the pioneer, exaggerated his conclusions and carried them to absurd excesses. Lombroso had at last to raise his voice against the extravagances into which he was dragged. Besides various absurdities, there were published some careful serious studies having for their themes the lives of Napoleon I, Leopardi, Ugo Foscolo, and Byron, in which it was made to appear that these men were all victims of heredity, and neither their virtues nor their vices were their own—studies of interest, academically considered, but of no tangible utility, and which did not add or detract one iota from the merits or demerits of their subjects. Against this method of dealing with men of genius as pathological subjects Mantegazza recently very rightly upraised his voice in the name of art, tradition, and history.

Space does not permit of our naming Lombroso's varied and voluminous writings, whose enumeration any biographical dictionary can supply. *La Donna Delinquente* (The Criminal Woman), written in collaboration with G. Ferrero, one of the most promising of the younger criminal anthropologists, of which an incomplete and inadequate translation appeared in England, aroused a storm of discussion on its publication four years ago, and was especially attacked by the adherents of the old methods. He has since published The Anarchists, in which he also takes unusual views with regard to these latter-day society pests—pests for whom society itself, as nowadays conditioned, he holds as alone responsible—and Crime

as a Society Function, which has aroused the fury of the clerical and moderate factions in Italy. Chips from the workshop of his extraordinarily prolific brain, ever evolving new ideas, new points of view, he scatters in the many articles he loves to write for English and American periodicals; but his most important scientific communications he reserves for the *Archivio di Psichiatria*, which he edits together with Ferri and Garofolo. His work is by no means perfect: he is apt to jump too rapidly at conclusions, to accept data too lightly; thus he was led at the beginning to overestimate the atavistic element in the criminal, and at a later date he has pressed too strongly the epileptic affinities of crime. Still, when all is said and done, his work is undoubtedly epoch-making, and has opened up valuable new lines of investigation and suggested others.

We said that Lombroso's first studies were directed to the pellagra, that strange and terrible disease which annually mows down such a vast number of victims in the fair land of northern Italy, and which is a luminous proof of the grave financial condition of the laborers in some of the most beautiful and richest regions of the world. Concerning this terrible illness, which densely populates Italian madhouses, all students of natural science have long been gravely occupied. For the terrible increase in lunacy noted by Italian statistics in the last five years the pellagra is largely responsible. Psychiatry, which has abandoned the old methods in Italy, is no longer a jailer employing the methods of an inquisitor, but a science that seeks for ultimate causes and remedies, and, conjoined to economic and political science, endeavors to restore to society a large contingent of forces which would otherwise be destroyed by disease. Especially active in this department is Enrico Morselli, at present director of the hospital attached to the Genoa University. Morselli is in the flower of his life, and much may be still hoped from him. Like Lombroso, he is small of stature and

ENRICO MORSELLI.

square built; like Lombroso, he has piercing eyes that shine forth acutely from behind glasses that he always wears. Psychologist, anthropologist, psychiatrist, philosopher, and literary man, Morselli has right to all these titles, and in each branch he is noteworthy. He was born in Modena in 1832, and studied at his native university, carrying off high honors. As a mere student he attracted attention by disputing the conclusions of a noted celebrity on some anthropological points, proving himself right. For a while he was the assistant of Mantegazza in arranging his Anthropological Museum, one of the finest as well as one of the most important in Europe. When only twenty-eight he was called to preside over the Turin lunatic asylum, and soon distinguished himself by his profound knowledge of everything connected with the study and treatment of the demented. Besides attending to his profession he found time to write a number of works dealing with normal and abnormal mental maladies, whose mere enumeration would fill pages, some of which, like his work on Suicide, have been translated into English. Morselli's latest work was a reply to Brunetière's assertions regarding "the bankruptcy of science," demonstrating that here was a case in which the wish was father to the thought, and for which no real foundation existed.

Paolo Mantegazza has been dealt with at length in these pages, and we need not go over the ground again. What is needful to say is, however, that he has been left behind in the rapid onward tramp of his younger colleagues. Mantegazza is perhaps entitled to lay claim to the name he loves to sport, that of the father of Italian anthropology; but, according to the more precise views of our day, he can hardly be regarded as a real scientist. As is often the case, the sons have outstripped the father, who now combats the views of his legitimate offspring. A reproach cast at Mantegazza, it would seem not without reason, is that he too closely follows Molière's precept, "*Je prends mon bien où je le trouve*," and that he has passed off as his own the conclusions and the work of German scientific men. Another reproach that is certainly well founded is his manifest delight in handling obscene themes, and handling them not in the calm, scientific spirit that removes from them a real obscene character, but treating the details with a gusto that reveals how these prurient matters rather delight than disgust him, and what is worse, these works are written in popular language, frankly appealing to a popular rather than a scientific audience. To this class belong all his works on Love, on Women, on the Art of taking a Wife, of Being a Husband, etc. It may safely be asserted that his fame is steadily declining, and that his want of perseverance and observation is itself to blame for this. By nature Mantegazza was endowed with a fine

and versatile intelligence, but he has lowered it in the search after cash and easy success. This handsome old man, with the face and smile of a satyr, is a familiar figure on the streets of Florence.

The number of men who are strict anthropologists without being sociologists is extraordinarily great in contemporary Italy, and there is none of them who has not done good and original work. Limits of space oblige us perforce to pass them by, in order to speak of yet others of the new school created by Lombroso's theories, and who take rank in the files of criminal anthropology, a science far more interesting to the general reader than that which deals with biology pure and simple. To this section in the first rank belong the alienists, besides a large number of lawyers, judges, and journalists. The highest position among them belongs indubitably to Enrico Ferri. His verdict, like that of Cesare Lombroso, is constantly appealed to in complicated criminal cases where the sanity or the natural proclivity to crime of the person is in question. A man of really unusual physical beauty is Enrico Ferri, as well as of charm of manner and of eloquence which, when stirred to a theme dear to his heart, carries all before it. Enrico Ferri was born in 1856, in the neighborhood of Mantua, a city whose very name in Austrian days was synonymous with cruel despotism, for this and Spielburg were the favorite fortresses of the German persecutors. At a tender age he lost his father, and his mother, left in straitened circumstances, had a hard struggle to give her only child an adequate education. Already at the university Ferri distinguished himself, publishing a thesis which dealt with criminal law. When Lombroso published his great work on Criminal Man, Ferri was at once attracted by its scientific nature and sought to become acquainted with its author. Since then they have been fast friends as well as co-workers. In 1881 he was called to fill the chair of penal law at the University of Bologna. His opening discourse dealt with the theme which was to prove the first draft of his great work, Criminal Sociology, a work which has been translated into many European tongues. The lecture was entitled New Horizons in Penal Law. He says: "It was in this inaugural discourse that I affirmed the existence of the positivist school of criminal law, and assigned to it these two fundamental rules: 1. While the classical schools of criminal law have always studied the crime and neglected the criminal, the object of the positivist school was, in the first place, to study the criminal, so that, instead of the crime being regarded merely as a juridical fact, it must be studied with the aid of biology, of psychology, and of criminal statistics as a natural and social fact, transforming the old criminal law into a criminal sociology. 2. While the classical schools, since Beccaria and

Howard, have fulfilled the historic mission of decreasing the punishments, as the reaction from the severity of the mediæval laws, the object of the positivist school is to decrease the offenses by investigating their natural and social causes in order to apply social remedies more efficacious and more humane than the penal counteraction, always slow in its effects, especially in its cellular system, which I have called one of the aberrations of the nineteenth century."

Ferri has occupied himself less with the instinctive than with the occasional criminal, and his clear and philosophic spirit has placed him at the head of criminal sociologists. Elected to Parliament even before the age of thirty, previous to which he could not take his place, according to Italian law, he began an avowed liberal, but soon passed over to the ranks of scientific socialists, whose acknowledged leader he has since become. He also holds the post of professor of penal law at the Roman University. But his home is on the vine- and olive-clad shores of Etruscan Fiesole, within a short walk of Florence. Of his great work on Homicide we have treated at length in these pages. Though in some points he has grown to differ from him, Ferri continues to venerate his master Lombroso, and with rare eloquence defends his theories from attacks at moments when the less eloquent scientist seems silenced by the arguments of his adversaries. It was due to his energy, conjoined to the initiative of Lombroso, that the first International Congress of Criminal Anthropologists was held in Rome in 1885, which constituted the installation of international criminal anthropology in sight of the European public. The second was held at Paris in 1889. It was there that the scientific misunderstanding arose, which was still more openly affirmed at the third congress held at Brussels in 1892, but was finally and conclusively beaten down at Geneva at the fourth congress in 1896; a result in a large measure due to Ferri's fascinating, all-persuading eloquence. In a letter written to me he has stated the whole matter so clearly that I can not do better than reproduce the same: "As you know, the positive school of criminal studies was consolidated in Italy by the contemporaneous publication in 1878 of the second volume of the *Uomo Delinquente*, of my volume on the Imputableness and Negation of Free Will, and of the pamphlet of Garofolo on the Positive Criterion of Penalty. In these first affirmations there naturally preponderated the conclusions of Lombroso, which gave and left on the public the impression that the new school only studied the criminal from his organic side as a biological monstrosity. Yet, in 1880, I had published my studies on Criminals in France from 1826 to 1878, in which I expounded the natural factors of the three orders

of crime—anthropological, physical, and social—laying stress on the social causes that conduce to crime. As a reaction from the aforenamed impression in Italy, Turati, Colajanni, and Battaglia published in 1882 to 1884 pamphlets and volumes maintaining that crime is an exclusively social phenomenon. I replied to Turati—Crime and the Social Question—with the volumes on Socialism and Criminality (1883), now out of print, where I combated: 1. Artistic and romantic socialism while recognizing the fundamental truths of scientific socialism. 2. The unilateral theory that crime is the product *only* of social factors, and that, therefore, with time it must certainly disappear. Continuing to maintain these two propositions, even after my avowed adhesion to scientific socialism, it has come about that in Italy this unilateral thesis has gradually become abandoned even by socialists. On the other hand, this thesis was taken up again in 1885 at the congress in Rome, and above all in 1889 at Paris, and in 1892 at Brussels by the French anthropological criminal socialists—Lacassagne, Tarde, Topinard, Corée, etc.—who succeeded in spreading the belief that there exists a French criminal anthropological school founded on the theory that the criminal is an exclusively social phenomenon—a thesis that had, for the matter of that, already been sustained in Italy by the socialists. It is thus that was circulated among the international public, who can not read Italian publications unless they are translated, the impression that opposing the Italian school there was a French school; the former maintaining the exclusively biological origin of the criminal, while the latter regarded his genesis as exclusively social. The congress at Geneva has cleared up this misunderstanding, which has lasted too long. Crime is a phenomenon whose origin is both biological and social. This is the final conclusion which the Italian school has proclaimed since the beginning of its existence."

It is noteworthy and also significant that almost all thoughtful Italians who have dedicated themselves to the studies of anthropology in general and criminal anthropology in particular are socialists in politics. Assiduous, dispassionate observation of mankind would seem to have brought them to this conclusion. A leader in the Italian Parliament in this sense, as well as a gifted criminal anthropologist, is Napoleone Colajanni, by original profession a doctor, but now too absorbed in his political duties to practice. Colajanni is by birth a Sicilian, and has much of the quick, fiery temperament of these islanders, in whose veins the blood courses hotly. A facile orator, his speeches always command attention in Parliament, while his rigid, incorruptible honesty makes him esteemed in a *milieu* of unscrupulous politicians and wire-pullers. As philanthropist, as politician, he was

early attracted to study the problems of misery and crime, whence resulted his great work on Criminal Sociology. Like Ferri and all the other thoughtful students of the criminal, he has seen the direct bearing on criminality of what he himself well calls "social hygiene." He points out how we may neglect the problems of social organization, but must do so at our peril. In many respects he is opposed to Lombroso. He holds, for example, that Lombroso has too much accentuated the atavistic element in the criminal He agrees with those who deem that of a great number of modern habitual criminals it may be said that they have the misfortune to live in an age when their merits are not appreciated. Had they lived in the world a sufficient number of generations ago, the strongest of them might have been chiefs of a tribe. As Colajanni has said: "How many of Homer's heroes would to-day be in convict prisons or at all events despised as unjust and violent!" He has strenuously combated Lombroso's indiscriminate method of collecting facts, and compares it to Charles IX's famous order on St. Bartholomew's Eve: "Kill them all! God will know his own."

And now it is time we should speak of Garofolo, the Neapolitan lawyer who, accepting generally the conclusions reached by Lombroso and Ferri, has become the most distinguished jurist of the moment, the pioneer of the reform of law through the method of natural science. His Criminology is marked by luminous suggestions of wise reform. Like Morselli, Garofolo does not blindly follow where his compeers lead. His latest volume, entitled Socialistic Superstitions, has excited much wrath and astonishment in socialistic and anthropological camps, and was severely combated, especially by Ferri, who wrote a pamphlet on purpose to confute the publication. R. Garofolo was born in Naples, in 1852, of an old patrician family, hence perhaps by atavism he is debarred from being a socialist. He holds the position of professor of law and penal procedure in his native city, and was intrusted by the Government in 1892 to draw up a scheme for the revision of the penal code. Garofolo has occupied himself chiefly,

R. Garofolo.

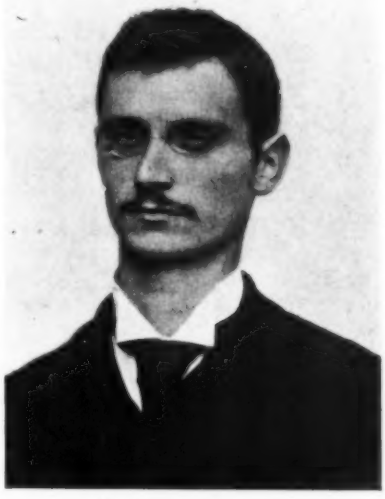
nay, entirely with the legal side of criminal anthropology, and his great work Criminology deals with the means of repressing crime quite as much as with its nature and causes. He has also studied the question of what reparation is due to victims of crime. His only flight into sociology has concerned his attack on socialism, in whose curative Utopia he does not believe.

Among the latest contributors to this fascinating science the highest places belong to three young men: Scipio Sighele, Guglielmo Ferrero, and A. G. Bianchi. All three are journalists, all three distinguished by the same qualities of keen observation, of more than ordinary cultivation, with sometimes a tendency to write a little hastily and to jump to conclusions too rapidly. This reproof especially concerns Sighele, who has allowed himself to judge and write of matters English and American of which he has but the most superficial and second-hand knowledge. Here the newspaper writer has done wrong to the scientist. Sighele made his name with an admirable book entitled The Criminal Crowd, which a French writer has thought fit to appropriate in outline and almost entirely in substance, obtaining for it the honor of translation into English, while the real author has been left out in the cold. Able, too, is The Criminal Couple. A paradoxical pamphlet directed against parliamentary government, and revealing the failure of a system on which the hopes of Europe were once based as the sheet-anchor of liberty, excited some attention on its appearance in 1895, and was dealt with at length in Blackwood's Magazine. His last work, on Individual Morality as opposed to Public Morality, inspired by the doubtful morality of Signor Crispi's government, also aroused discussion, especially among Crispi's adherents, who looked on the book as a bit of special pleading in favor of their master's dubious political proceedings.

SCIPIO SIGHELE.

Guglielmo Ferrero is a Piedmontese, and belongs to an old

aristocratic family of Turin. Although his name is already well known in scientific circles, he is still little more than a youth. Together with Lombroso he wrote the Criminal Woman, spoken of at length in these pages, and which at once brought him to the front, as all the world knew that it was he who collated and collected the facts therein contained. His first independent work was that most remarkable one dealing with Symbols, of which we have also spoken before. His latest publication deals with Crispi, whose personality he subjected to a scientific analysis qualifying him as a born madman. Ferrero, too, is a convinced socialist, and on this account was arrested during the reign of terror that prevailed in the course of the last months of Crispi's dictatorship. He was ordered to leave Italy, and, profiting by this enforced exile, he visited Germany and learned the language and the condition of anthropological studies in that land. He has but recently returned. His magazine articles are always able, and marked by a high and independent tone.



GUGLIELMO FERRERO.

A. G. Bianchi, a Milanese by birth, is also young. Not rich, like Ferrero, he had to make his own way, and entered into journalism as a means to obtain daily bread. He began life as a railway official, writing at the same time reviews of new books, Italian and foreign. Together with a colleague he founded a paper called *La Cronica Rossa*, and it was in these pages that he began to occupy himself with scientific literature, and to prove himself an enthusiastic follower of Lombroso. He entered the best Italian newspaper, *Corriere della Sera*, as its legal editor, and thus became even more enamored of criminal anthropology. Intelligent, industrious, studious, he dedicated himself to the new science with ardor, and in a short time became allied to Lombroso and Morselli, who both applauded his zeal and his methods of working. Together with Sighele he issued a publication on Criminal Anthropology, richly illustrated with pictures, diagrams, and statistics, which met with favor even outside of strictly scientific circles. A remarkable book published by him is the Romance of a Born Criminal, the

autobiography of a convict, founded on authentic papers committed to his hands by the eminent psychiatrist Silvio Venturi, director of the lunatic asylum at Catanzaro, a book which was translated immediately on its appearance into German, but which no English publisher has had the courage to issue, though it states at once in its preface that its scope is purely scientific, and that the word "Romance" is employed in a subjective sense. This piece of pathological literature throws a lurid light upon the inner nature of the criminal. Bianchi has written a long and careful preface, in which he points out just how and why this human document has scientific value. As yet, Bianchi has not had time to write many books, but his careful, studious articles are all of value, and denote his knowledge, intuition, and observation.

Limits of space, which we have already exceeded, oblige us to leave unmentioned yet other valiant followers of criminal anthropology in Italy, but we hope we have said enough to prove that this science has in the peninsula both numerous and able adherents, and that Italy is justified in considering herself at the head and front of studies of this nature—a position which, indeed, few dispute to her. Seeing how useful is this science as an auxiliary to the right study of history, literature, and political economy, it would be well if its propagation were more encouraged at universities, in place of philosophy and metaphysics, which, when untouched by this new breath, have become fossilized and are as arid as they are sterile.

THE QUESTION OF WHEAT.

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I.

A YEAR of abnormal conditions in trade and industry brings out a plentiful crop of predictions of great approaching changes. If the prophets of economic revolution, who base their prophecies upon half-digested statistics, were to be gathered, and their confident prognostications exhibited in the light of ascertained results, or even of rationally tested tendencies, the asylum of Laputa, as described by Swift, would be of secondary interest. We have been treated in recent years to many a sensational diagnosis of social trouble, fraught with dangers to the body politic. No one will deny that such dangers exist and are even threatening to break upon us or to carry on their operation until only an explosion can clear the atmosphere and permit a renovation on new lines of activity.

It is because there are a number of true diseases of society to be met that the studied attempts to create new problems, neither imminent nor at present active, must be deprecated. When these attempts are based upon half knowledge of facts, to use no stronger term, they are still more to be discouraged as hostile to the welfare of the community, and as giving rise to policies that can only end in mischief or disaster. Much of the social unrest which finds expression in political activity has been bred and fostered by the agitation of half truths or of falsehood clothed in a quasi-scientific garb.

At present the question of the wheat supply of the world is prominent, and is being discussed in a manner that produces alarm, and with the alarm encourages every social quackery for its alleviation. Because the year 1897 was a phenomenal year in wheat—every one will admit that to be a fact—the fears of future famines and a general want throughout all wheat-consuming countries of the world are harped upon and magnified until the evidence seems to amount to a demonstration, and nothing remains for the civilized world but to become reconciled to a lowering of the standard of comfort, the substitution of a cereal of secondary quality for one that ranks next to meat in high food efficiency. The corners of the world are ransacked for figures to bear out so dire a prediction. Decreasing acreage devoted to wheat, reduced yield of crops, falling per-capita consumption of wheat, and market prices that seem to bear out the fact of an approaching if not existing famine, every incident of depression is carefully collated, and a picture drawn which casts into shade the fearfulest famine experienced in the world's history.

The error underlying such a presentation is a very common one, for it involves a partial study of a problem where the factors are so many as to present a double difficulty. Not only must the facts and statistics be collected, but they must be arranged in such a form as to be both intelligent and intelligible. Every statistician does not deserve implicit confidence. The most difficult task of the user of statistics is to attain to a proper appreciation of the relative value of compilers of statistics. Even Government work, though covered by the shield "official," is not above criticism, and if a bureau with the weight and authority of Government behind it is liable to go wrong, how much more liable to this mischance is an individual, whose interest may mislead, or whose eagerness to establish a thesis may blind to certain important phases of the problem. In the statistical treatment of any question the greatest care is needed to test fully the combination of figures presented, for a flaw in arrangement may lead to ridiculous conclusions.

These precautions of appreciating men and their work are all the more necessary in matters where the statistics at hand are im-

perfect or incomplete. This is the case with all agricultural statistics, and especially so with the returns of crops, always an estimate of uncertain foundation. No two fields of grain are exactly the same, and the variation of field to field is exaggerated when it is made the basis for an estimate of the condition or yield of crops in a township, a community, or a State. The observers are different, and each observer would look at the same field through the medium of a personal equation. No general rules can be laid down for preparing these estimates, and much latitude must be given to the agent. In our own crop service, as conducted by the Department of Agriculture, the estimates of crop condition are based upon reports from 56,700 regular correspondents, reporting monthly, and 140,500 special correspondents, reporting at particular seasons of the year. Even the Secretary of Agriculture is not satisfied with this machinery. "I am much impressed," he writes in his report for 1897, "with the extreme cumbrousness of the system of crop reporting that has been in use in this division" (of statistics) "during the last few years. Instead of conducing to completeness and accuracy, it would appear from the report of the statistician to in some measure defeat its own object by its unwieldiness, and by the fact that the indefinite multiplication of crop reporters weakens the sense of individual responsibility." The defects of the system have been recognized by others, who are obliged to be informed on the crop conditions, and who have been compelled to look elsewhere than to the Department of Agriculture for crop returns and estimates. The "commercial estimates" prepared by experts, and checked by actual receipts or movement of grain, find a more ready acceptance than do the "official" estimates. In the last season the commercial estimate placed the crop of wheat at 550,000,000 bushels, while the department forecast a yield of only 450,000,000 bushels, a difference too large to be admissible in a statistical examination of the same subject. The reporters for the department, practical farmers as most of them were, did not wish to report a heavy crop, lest the market be influenced and prices fall. A short crop appeals more to their interest, and their estimate inclines, consciously or unconsciously, to an understatement of conditions. "The best authorities are now agreed that in 1891 the bureau (of agriculture) underestimated the American wheat crop by 73,000,000 bushels, in 1892 by 64,000,000 bushels, and in 1893 by 79,000,000 bushels." * "In 1894 the Government estimate in December of the wheat crop was 460,000,000 bushels, while the best commercial estimates of that year were 525,000,000 bushels." †

* New York Evening Post, August 11, 1897.

† Ibid., August 16, 1897.

It must be admitted that there are unusual difficulties in estimating such a crop as that of wheat. It is not purely a commercial crop, where the whole product comes into the market to be recorded commercially, as is the case with cotton. A part is consumed on the farm, another part is retained for seed, and the proportion of crop brought to market varies with the price offered and the necessities of the farmer. There are many opportunities of error in arriving at the resultant of these patent conditions, without undertaking to measure other influences that tend to check or promote deliveries and free movement of wheat from the producer to the market, not to speak of the international competition that overshadows the whole subject. It is not a little absurd to dogmatize in the face of so many uncertainties, and all the more absurd when a limited space of time is taken for study. In commerce, the shortest period on which to determine the trend of movement should not be less than twenty years, and as many more years as the returns will permit strengthen the argument. In agriculture the same rule holds. There is an undoubted periodicity in the ebb and flow of industry and agriculture, of commercial and financial movement—waves of prosperity and depression. It would be as misleading to accept a year of depression for a standard as to apply a year of prosperity. In the wish to throw some statistical light upon the position of wheat, I have prepared some notes upon the conditions surrounding the production of this important cereal in different parts of the world, and the conditions controlling its commercial movement in some of the leading markets. As the trade returns of import are more accurate than those of export, I begin with a consideration of the great free wheat market of Great Britain.

In 1849 the duty upon imported wheat was fixed at the nominal rate of one shilling per quarter. In ten years the trade had adapted itself to this rate, and no disturbing influence was exerted by any threatened change of rate, so that 1860 may be taken as a fair starting point for this examination. In that year the United Kingdom imported 25,484,151 quarters (one quarter equals eight bushels) of foreign wheat. Of this quantity the larger part—sixty-seven per cent—was obtained frm European countries, of which the more important were Germany and Russia. Outside of Europe the leading sources of supply were the United States, Egypt, and British North America. The general relation of those countries is shown as follows:

Russia	5,638,299	quarters.
Germany	6,542,601	"
United States	6,497,335	"
Egypt	854,815	"
British North America	794,829	"

The civil war in the United States and the financial measures taken by our Government had a temporary influence, first, to stimulate exports, and secondly, to discourage them after the primary effect of an irredeemable paper currency had passed. The reaction was such as almost to destroy the ability of the United States to export wheat, and it was not till some years after the return of peace that its wheat recovered its true position in the English market. This course of the wheat trade was the most notable incident in the history of that trade since 1860, and a few figures are given to show its remarkable rise and fall. The comparison is of further interest as developing apparent sympathetic fluctuations in the imports from British North America and Egypt. The Canadian flow may be accounted for by the conditions then prevailing in the United States, but the Egyptian stands alone in its curious reflection of the rise and fall in American export.

Year.	Exports from the United States.*	Imports into the United Kingdom from			Gazette price of wheat per quarter.	
		United States.†	British North America.	Egypt.		
	Bushels.	Cwt.	Cwt.	Cwt.	s.	d.
1860.....	4,155,153	6,497,335	794,829	854,815	53	3
1861.....	31,238,057	10,866,891	2,381,275	1,472,514	54	4
1862.....	37,289,572	16,140,670	3,732,959	3,289,156	55	5
1863.....	36,160,414	8,704,401	2,093,997	2,319,590	44	9
1864.....	23,681,712	7,895,015	1,225,523	366,868	40	2
1865.....	9,937,876	1,177,618	306,765	10,063	41	10
1866.....	5,579,103	635,239	8,789	33,831	49	11
1867.....	6,146,411	4,188,013	683,127	1,451,774	64	5
1868.....	15,940,899	5,908,149	557,443	3,219,536	63	9
1869.....	17,557,836	13,181,507	2,723,053	1,004,479	48	2
1870.....	36,584,115	12,371,922	2,838,361	104,950	46	10

In the period the need of England for foreign wheat increased, and yet one of the best countries of supply was, to all purposes, taken out of the race. In the five years (1861 to 1865) the average annual import of wheat was 24,902,576 hundredweight, and from 1866 to 1870 it was 31,807,745 hundredweight. The quantity received from Germany remained almost the same in the entire period, but the failure of the United States was in part made good by Russia, and in part by other countries of Europe, from which a small and somewhat unusual supply had been counted upon in the years past. The sudden appearance of these comparatively new sources of wheat, and their equally sudden disappearance, mark the exceptional conditions that gave them a temporary importance.

* Fiscal years, from Commerce and Navigation.

† Calendar years, from English trade returns.

Year.	Imports of wheat into the United Kingdom from			
	France.	Austria.	Turkey.	Chile.
	Cwt.	Cwt.	Cwt.	Cwt.
1861	783,913	378,244	1,005,768	178,980
1862	974,285	785,451	1,759,411	284,735
1863	147,481	72,722	415,519	281,229
1864	587,105	11,041	482,994	190,881
1865	2,252,873	579,280	574,185	144,861
1866	3,473,130	1,326,529	528,433	308,810
1867	597,405	542,635	2,446,638	1,946,227
1868	56,414	1,004,701	3,066,597	1,309,575
1869	468,274	1,030,563	2,379,906	567,107
1870	253,644	60,472	489,421	599,337

Had this situation been discussed in the year 1866 or 1867, the critic might have concluded that America and Egypt were destined to fall out of the race as suppliers of wheat, and Russia, France, and Chile were to be the future wheat-growing countries. Two years later a new arrangement would have been found necessary, for Austria and Turkey, the United States and Egypt were the rising countries. So uncertain is a conclusion based upon a limited examination. Neither combination of countries would have been accurate, for the decade 1870 to 1880 wrought a revolution in wheat production the true extent of which it is even now difficult to appreciate, and the effect of which is yet felt. A blow was struck at European wheat interests from which they have never recovered, and from which the probability is they never will recover. This revolution may be studied in clear outline in the conditions in Great Britain.

The last vestige of a duty on imported wheat in the United Kingdom was removed in 1869. The duty of 1*s.* per quarter, which had been collected since 1849, could not have exerted any influence in encouraging the culture of wheat in the kingdom. In 1867 the acreage under wheat was 3,367,876 acres, and the deliveries of wheat in 170 towns, as reported to the Government, were 2,724,673 quarters. The price of wheat as given in the gazette was such as to encourage some expansion of acreage, but in two years prices again tended downward, and acreage was contracted; so that in 1875 the acreage returned was 3,342,481 acres, and the deliveries were 2,515,098 quarters. To that year the conditions appeared normal so far as the home wheat interest was concerned.

A very different story is told by the imports. From 1871 to 1875 the average annual import was 43,756,956 hundredweight, and from 1876 to 1880 it rose to 52,696,932 hundredweight, or more than double the average import for 1861 to 1865. So large an increase in demand could not be met by continental Europe, though Russia did respond for two years, and at a rate which prom-

ised much. In 1871 Russia gave 15,654,000 hundredweight, and in the following year 17,855,658 hundredweight, a figure that was not again attained until 1888. This effort was all the more necessary, as Germany cut down her quota of supplies from an average of more than 6,000,000 hundredweight a year to one of 3,000,000 hundredweight, and after a slight recovery in 1877 and 1878 began to fall rapidly in the rank of wheat exporters to insignificance after 1880. Thus, at a time when England required larger supplies of foreign-grown wheat, Europe failed her. From 1871 to 1875 Europe gave an average of 18,138,823 hundredweight, and in 1876 to 1880 only two thirds of that quantity, or 12,806,670 hundredweight. Outside of Europe must be looked upon to make good the growing deficiency of European supplies.

The reason of this change of sources is not far to seek. The land in Great Britain could be turned to more profitable use than for wheat-growing. Writing in 1878, before the full force of the current in agriculture could have been felt, Sir James Caird said: "'Excluding good lands capable of being rendered fertile by drainage, we appear to have approached a point in agricultural production beyond which capital can be otherwise more profitably expended in this country than in further attempting to force our poorer class of soils. It is cheaper for us as a nation to get the surplus from the richer lands of America and southern Russia, where the virgin soil is still unexhausted; or from the more ancient agriculture of India, which, with its cheap and abundant labor more skillfully applied, and its means of transport extended and better utilized, seems destined to become one of the principal sources of our future supply of corn (wheat)." *

At the time this was written it was assumed that the cost of transporting a bushel of wheat from a distant country was about the same as the rent paid by the wheat farmer in Great Britain. Given ordinarily good returns, the home-grown wheat could meet the foreign wheat on an equality. Two circumstances combined to destroy this relation. The one was an extraordinary succession of bad seasons in England, and the other was such a development of production abroad as to result in a permanently lower range of price. This situation brought to bear an enormous pressure on agricultural properties, and a tendency to reduce rents.

The first notable drop in the wheat acreage in England occurred in 1876, and was due to the great floods in the autumn seedtime of 1875, which prevented a considerable proportion of the land being sown.† In 1874 the acres returned under wheat were 3,391,440; in 1875, 3,128,547; and in 1876, only 2,823,342, a loss in two

* Caird. The Landed Interest, p. 6. † Ibid., p. 9.

years of one sixth of the area. There was a recovery of about 200,000 acres in the years 1877 and 1878, but not only was this recovery lost in 1879, 105,000 acres more went out of wheat cultivation. The crop returns of these years tell a doleful story. In 1875 they reported "much under average"; in 1876, "under average"; in 1877, "much under average"; in 1878, "over average"; and in 1879, thought to be the culmination of a series of bad years, "much under average." From 1866 to 1870 the average yield per acre was 26½ bushels, but from 1875 to 1880 this average was twice touched, and in 1879 the complete returns gave a yield of only 18 bushels to the acre, a record that marked a year of disaster.

It will be of interest to show how far these adverse conditions were due to natural causes, and therefore beyond the power of farmer or legislator to modify or even to forecast. The weather of 1875 was "cold, ungenial, and unsettled. The spring was one of the coldest, bleakest, and most backward of the century. In July came heavy, chill, and destructive rains, destroying the hay and the roots, and blighting the prospects of any abundant corn crops." * In the next year, 1876, the hot weather of June and July came too late to mature the crops, and the result was not satisfactory—a crop "of a very imperfect character." †

Conditions were brighter in 1878. The crop was only an average one, but that seemed grateful to the farmers after three bad harvests in succession. Whatever hopes were raised by favoring markets and improved returns were dashed in 1879, a year of disaster in agriculture, and giving the worst crop of wheat since 1816.‡ As agriculture represented one tenth of the total produce of the country, and hardly a branch of agriculture escaped injury, the mischief was so pronounced as to call for an examination by a royal commission. The London Statist, a conservative and able judge, thus summed up the agricultural operations of 1879, a year that many thought marked the total ruin of the British farmer: "There can be no doubt as regards the corn crops that last season was one of the worst on record. After the harvest each succeeding estimate of the yield of the wheat crop appeared to be worse than its predecessor, and these low estimates have been fully confirmed by the remarkable falling off in the quantities brought to market. The reduction of yield must have been at least thirty per cent below the average. . . . The barley harvest has also been most deficient, the result being peculiarly disastrous to the excise revenue. In minor crops, such as hops, there has been quite as serious failure. The season has also been far from favorable to green crops and live stock." *

* London Economist, March 11, 1876.
† Ibid., March 10, 1877.
‡ London Times.
* Statist, January 31, 1880.

It is not to be denied that other causes contributed to depress agriculture in England—causes which operated on every form of industry and commercial activity. The Franco-Prussian War checked exports to two very good customers of English industries; the financial crisis of 1873 was world-wide in its influence; in 1875 came the collapse of many foreign loans, ending in default, ruin, and great suffering to the many who had put their savings into such risks. In 1877 Russia and Turkey went to war, one of the effects of which was to close the ports of both countries and thereby lessen the quantity of wheat exported. In 1878 the City of Glasgow Bank failed and produced a commercial crisis—the last of the important events before the revival of trade and industry began to make itself felt in 1879. But it was the climatic conditions that weighed most heavily upon the farmer, preventing him from meeting his losses, or even from putting himself in a condition to meet the competition of the foreigner. He no longer enjoyed a natural protection of distance. That margin had long since been wiped out by falling prices in the home market, in the places of production, and in the cost of transportation. In 1872 the gazette price of wheat was 57*s.* the quarter, and the quotation did not fall below 55*s.* until 1875, when 45*s.* 2*d.* was given—a low return in comparison with the previous ten years. A rise brought it up to 56*s.* 9*d.* in 1877, but a fall to 46*s.* 5*d.* in 1878, severe as it was, gave a price that has not since been recorded. From that year the market value of wheat steadily declined.

The English farmer thus contended against a double pressure—bad seasons and a foreign competition that was in a position to dictate prices. Against both he was powerless, though he could break the full force of the blow from competition by changing his culture, as in growing barley in place of wheat, or by more carefully selecting his lands, and appropriating them to the most distinctly suitable form of crop. As a fact, these measures were adopted on an extensive scale. In England the period 1870 to 1879 gave a decreased acreage under wheat of 529,000 acres, and an increased acreage under barley of 229,000 acres.

At the instance of the royal commission, two of its members visited the United States, and in an able report gave figures to prove that wheat could not be grown in the United States in an average of years and delivered in Great Britain much below 48*s.* a quarter. This would have been comforting had it been capable of demonstration. Unfortunately for the farmer, the market quotations and the import movement of wheat directly disproved such a hard-and-fast limit. The highest authority on agriculture, Mr. Caird, reiterated his warnings of continued pressure: "Our system of agricul-

ture is thus already beginning to accommodate itself to the change which American competition will certainly render necessary. In the northern and western parts of the country, where live stock predominates over corn, and where the labor bill is comparatively moderate, the effects of this connection are little felt, and the suffering that has arisen of late years has been more the result of ungenial seasons and grazings unthrifty for the herds and flocks. In the corn districts the loss has been greater, because not only were the crops inferior, but prices were low, while the labor was very costly. In the least fertile tracts of poor clay, where every operation is expensive and the land is unkindly for grass, it must either go out of cultivation or be turned to some other purpose than that of growing food. It is hopeless to expect that such soils can maintain their old position. Indeed, nothing but the greatest prudence and freedom of action will carry our landowners and farmers, on even the better class of corn lands, through the earlier years of the competition on which they are entered." *

The estimates of the losses suffered by the British farmer through the succession of "calamitous" seasons from 1873 to 1879 varied widely, but all agreed in naming a very large amount. Only two good crops in ten years, and the last of the series, that of 1879, the "worst of the century," naturally gave a severe and, as it proved, a lasting blow to wheat-growing in England. Indeed, the loss was placed at one third of the total farming capital of the kingdom, and in many corn (or wheat) districts more than one half of the farmers' capital had disappeared. The acreage under wheat, the gazette price, and the imports of foreign supplies during this period make an interesting and suggestive study.

Year.	Wheat acreage.	Gazette price per quarter.		Total imports.	Imports from Europe.
	Acres.	*s.*	*d.*	Cwt.	Cwt.
1871	3,571,894	56	8	39,389,803	20,667,593
1872	3,598,957	57		42,127,726	26,543,585
1873	3,490,380	58	8	43,863,098	14,392,135
1874	3,630,300	55	8	41,527,638	10,109,357
1875	3,342,481	45	2	51,876,517	18,981,444
1876	2,995,957	46	2	44,454,657	13,208,705
1877	3,168,540	56	9	54,269,800	19,642,475
1878	3,218,417	46	5	49,906,484	14,614,540
1879	2,890,244	43	10	59,591,795	11,908,821
1880	2,909,438	44	4	55,261,924	4,658,807

These figures alone would be sufficient to indicate a revolution in the wheat interests of Great Britain. The acreage under wheat

* Address as President of the Royal Statistical Society, 1880.

decreased nearly one fifth, yet the price of wheat fell in more than the same proportion. The supplies obtained from European countries fell off in quantity, and would, indeed, have fallen to nothing had it not been for Russia. With her black-earth region, rapidly settled by her own population, she was in nearly the same position as the United States, and responded for a time freely to the demands of the English market.

The economic movement thus fixed upon English wheat interests by adverse conditions proceeded rapidly in the ten years following 1880, and the great changes occurrerd not in England itself, but in the development of competition among outside growers of wheat for export. In 1880 and 1881 it seemed as if the United States held a practical monopoly of the British wheat market. In these years nearly two thirds of the total imports came from the United States, and British India was the only competitor in sight, but far behind America in importance. The quantities of wheat taken from our producers have never since been equaled, and still stand as the record years in this one line of exports. For the rest of the decade the movement fluctuated within wide limits, and it seemed at times as if the position of American wheat in England was seriously threatened. Russia showed a remarkable increase in an ability to export, while British India, its own population not being consumers of wheat, was thought to offer an almost unlimited field for wheat culture and commerce, limited, in fact, only by the difficulties of assuring certain water supply and ready means of transport. A new and not unfavored competitor gave signs of activity in Australasia, while before the year 1890 experts were speculating upon the possibilities of Argentina as a wheat country. Europe, outside of Russia, was practically out of the race; but that loss was more than made good by so many new countries coming forward with a promise of abundant and cheap production. The former table on acreage and price in England is here continued for the decade 1881 and 1890:

Year.	Wheat acreage.	Gazette price per quarter.		Total imports.	Imports from	
					Europe.	Russia.
	Acres.	*s.*	*d.*	Cwt.	Cwt.	Cwt.
1881.....	2,805,809	45	4	57,147,933	5,680,921	4,046,849
1882.....	3,003,960	45	1	64,240,749	13,511,881	9,575,632
1883.....	2,613,162	41	7	64,138,631	18,523,701	13,346,762
1884.....	2,677,038	35	8	47,306,156	7,344,097	5,402,396
1885	2,478,318	32	10	61,498,864	15,778,873	11,975,644
1886.....	2,285,905	31		47,435,806	5,840,829	3,720,662
1887.....	2,317,324	32	6	55,802,518	7,796,303	5,501,380
1888.....	2,564,237	31	10	57,261,363	26,880,596	21,450,346
1889.....	2,449,354	29	9	58,551,887	28,649,886	21,320,304
1890.....	2,386,336	31	11	60,474,180	26,473,442	19,389,025

Interesting as has been the record of wheat imports into the United Kingdom for the twenty years from 1871 to 1890, the course of events since has been sensational in their number and suddenness. The famine of 1891 in Russia crippled her export trade for the time, and, indeed, threatened to destroy it by the necessity of creating deposits of grain to guard against the recurrence of so dread a visitation. A series of poor crops in India raised domestic prices of grains to a point at which shipments became unprofitable, and this weakening of wheat supply culminated in the plague and famine which wiped Indian wheat out of the European market. Argentina began to fulfill its promise of production, and after a meteoric progress collapsed in disaster, its entire crop being destroyed by a plague of locusts. Russia and the United States alone remained as a source of supply, and under the stress of demand the price of wheat rose rapidly in 1897. These various conditions may best be related in the next article.

The English wheat acreage meanwhile has gone steadily down under the strain of outside competition. In 1895 only 1,417,483 acres were returned as under wheat—a loss of nearly 2,000,000 acres since 1867. The prediction that the United States could not export wheat under 48*s.* per quarter has been answered by continued export with wheat at 22*s.* per quarter. A royal commission on agriculture can make no definite suggestion for its betterment, and the following tables express more eloquently than could any words the kaleidoscopic changes in sources of imports since 1890, all of which have depressed wheat-growing in England, while shuffling these outside sources of supply in a manner truly remarkable. As a record of sudden change, these figures could hardly be matched in recent economic experience:

Year.	Total imports.	Imports of wheat into the United Kingdom.			
		From Europe.	From India.	From United States.	From Argentina.
	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.
1891.....	66,312,962	18,126,326	13,005,785	24,194,945	2,478,456
1892.....	64,901,799	6,290,313	12,495,442	33,886,742	3,466,096
1893.....	65,461,988	10,619,692	6,196,096	32,262,848	7,845,587
1894.....	70,126,232	17,958,758	5,349,056	24,658,245	13,272,152
1895.....	81,749,955	27,095,355	8,802,950	27,084,120	11,400,360
1896.....	70,025,980	26,674,110	2,112,940	30,694,900	4,927,600
1897.....	62,743,280	19,470,280	572,760	34,603,200	933,100

A period of stress such as English agriculture has passed through leaves its permanent results, and the social changes wrought in the British Islands have been great and trying. The landowner has seen his rents fall to a point below which no profit can accrue from

keeping his lands under wheat. The land occupier has seen his profit wiped out, and has been forced to obtain a reduction in rent, or to migrate to the towns, colonies, or foreign countries. The farm laborer, never in even a good position, has found precarious work, and has become migratory in his restlessness. This has been followed by a rise in wages, through the scarcity of farm hands, but the employers complain that under higher wages less and therefore more costly results are obtained. The value of land in the return for taxation shows a great shrinkage. In 1872 the value of lands in England so returned was £48,964,149, and it increased each year, reaching a maximum of £51,811,234 in 1877. In 1895 it had fallen to £39,680,346—a decrease of twenty-three per cent, or nearly one fourth. This becomes the more striking when compared with the rise in the value of houses from £76,475,194 in 1872, to £133,511,890 in 1895. From these figures it may be judged how severe has been the crisis in English agriculture, yet a crisis that has not permanently increased the cost of wheat and thus burdened the other industries of the empire.

A SPRING VISIT TO NASSAU.

By EMMA G. CUMMINGS.

WITHOUT indulging in too familiar details of an ocean voyage, let me briefly sketch some interesting features of my visit to Nassau in the month of March, for the island of New Providence is unique and interesting on account of its wonderful flowers and trees as well as the curious customs of its picturesque natives.

One interesting bit of the voyage from New York was the sight of the "Sargasso Sea," which we reached the third day out, after crossing the Gulf Stream. We came upon water of an intensely dark, indigo blue, filled with lovely delicate floating seaweeds, such as we had never seen before. It seemed impossible to believe that the water itself was entirely colorless, and one young lady on board insisted that the captain must be wrong in saying it was the same as the rest of the ocean; whereupon the captain ordered a bucketful to be dipped up, when it was found to be no bluer than the rest.

The next day we reached Nassau. Clad in our thinnest summer clothes, we left the steamer outside the bar and were taken on a tender up to the wharf, where the usual crowd of natives had gathered to see us land. For the most part they were a leisurely and good-natured lot of colored people, for negroes far outnumber the whites. Looking over the rail on the other side of the tender, an

unusual sight met our gaze. A dozen or more boys in small boats, scantily clad, were clamoring, "Boss, please now a penny!" and as the passengers threw small coins, the nearly naked boys dived for them into the exquisitely clear green water, often catching them before they reached the bottom. They are expert swimmers, as the following story will show: A few years ago a wrecking crew was ordered from New York to take the cargo from a sunken vessel; but, before they arrived upon the scene, the natives had descended to the hold of the vessel with grappling irons, attached them to the cargo, and raised it.

As soon as we landed, our baggage was examined by the custom-house officers—important-looking colored men dressed uniformly in dark-blue trousers, with a red stripe down the side, white linen jackets, and white pith hats. Boys of every age and various cast of features, showing their gleaming white teeth, begged to take our parcels to the hotel. As we sat in the cage-like shed which serves as a customhouse we were at once impressed with the sense that the island of New Providence was indeed a foreign land, most picturesque, fascinating, and distinctly tropical, with its tall cocoa palms here and there waving above the other trees and the house-tops. Our attention was particularly attracted to the trees about the wharf and along the main street. At first we thought they were magnolias, and it was hard to believe they were not members of that family, so striking a resemblance do they bear with their large, shining leaves. They are known as almond trees, the Demerara almond (*Terminalia catappa*), but are not the almond of commerce.

COCOANUT PALMS.

A conspicuous tree, resembling the pine, is the cassowary

(*Casuarina equisetifolia*), so called from the likeness of its long, delicate branches to the hair of the cassowary, and equisetifolia, because its stems and leaves are like our common weed equisetum, or horsetail. This tree is a native of the East, and is introduced now

CASSOWARY TREES, BAY STREET.

through all tropical countries. The button tree (*Thespesia populnea*) is thus called from its buttonlike fruit, and is common about the town.

The vegetation was new and curious to our Northern eyes, each step revealing plants and trees hitherto unknown. How to know them was a problem, because we were interested in these beautiful surroundings, but could find no one who could give us reliable information. A few plants that were familiar to us in greenhouses in the North grow in Nassau as common garden plants. Some that we recognized were the poinsettia; oleanders, growing to the height of twenty-five feet, with flowers varying from white to pink and deep crimson; hibiscus, with hundreds of blossoms on a single shrub;

castor beans, morning-glories, lantanas, four-o'clocks, and tecomas, with their white and yellow blossoms, at this season the most conspicuous wild flowers; and the life plant (*Bryophyllum calycinum*), a single leaf of which, if pinned to the wall of a room, will send out rootlets and grow. These last are seen in every direction, and grow wild among the rocks. Orchids, air plants (epiphytes), and palmettos, which are so carefully cherished in our hothouses or homes, here run wild and cover large areas of waste land. Cacti, agaves and aloes are common, and from them good commercial fibers are made. Sisal hemp and sisal grass are terms used for fibers of probably more than one species of agave. They have always grown wild on the islands, and were formerly considered a nuisance. Of late years the production of sisal has formed a large industry, and hundreds of acres are given up to the growth of the plant, which thrives on the poorest soil. The cultivation of sisal is only exceeded in extent by the sponge industry, in which six thousand people and a great many small vessels are engaged, Nassau being the principal port for sponge trading in the West Indies. The men engaged in gathering the sponges go off on cruises of five or six weeks. They get the sponges by means of a hook attached to a long pole, and then leave them in the sun till the animal matter decays. They are then brought to the sponge exchange, sold in large quantities, and afterward taken by each buyer to his wharf. Here women are employed in cutting, trimming, and packing them for exportation.

In early spring, before the trees put forth their leaves—for there are many deciduous trees even in a tropical region—there are fewer flowers in bloom than later in the season. Some have their season of growth and rest, though the climate has a nearly equal temperature throughout the year, while other trees and plants, like tea and coffee, produce several crops annually. In tropical regions, sequence of crops depends largely upon a rainy and a dry season. The absence of grass is quite noticeable. Very few cows are kept, and this has its effect upon food, as condensed milk must always be used. A tree of great interest, particularly to those interested in the dissemination of seeds, is the sand-box (*Hura crepitans*). Its pods explode with a pistol-like noise, scattering the seeds to a great distance. I secured a good specimen, and packed it carefully in a box. Some five or six weeks later, when at home, I untied the pod and put it on the table with a collection of corals, shells, and curios from the West Indies. Coming home one day, I was told that it would be unsafe ever to go out again and leave Sam, the pet cat, alone in the sitting room, for he had been on the table and made great havoc, scattering sponges, shells, etc., all over the room. I rushed to see if any of my specimens had suffered, and found that not Sam, but

the sand-box, had been the cause of the disaster. Travelers relate many interesting and curious stories about the sand-box.

One day, seeing some curious-looking pods in a store, we inquired where they grew, and were directed to the yard of a good-natured and amiable negro woman. She designated two large trees as the King and Queen; a very pretty idea, since they are dicœcious—that is, one bears unfertile or staminate flowers only, and corresponds to the male, while the other bears fertile or pistillate flowers only, and corresponds to the female. The latter is the pod-bearing tree,

MONKEY TAMARIND TREES.

and the smaller of the two. The trees are very old, one having a girth of twenty feet at six feet from the ground. Its name, monkey tamarind (*Adansonia digitata*), is given from the fact that in Jamaica monkeys are sometimes caught while attempting to obtain the seeds from the large woody pods which the tree produces. The true tamarind (*Tamarindus indica*) of the West Indies is also a large tree with delicate spreading foliage, and is distinguished by its brown leguminous pods. We bought these at the market and ate the acid pulp which surrounds the seeds. With the aid of sugar it makes a palatable drink. When sold for commerce, and used for medicinal purposes, the pods are removed, but the seeds remain connected together by a fibrous string. There are several species

of trees in Nassau belonging to this same family, the *Leguminosæ*, having pulselike fruit, as the sweet pea and honey locust, although the pods vary greatly in shape and size. One of these, that loses its leaves in the winter season, has hanging upon its branches a great number of delicate pale-yellow pods, about eight inches long, which, swaying in the wind, so fill the air with a soft, murmuring noise that it has been called the singing tree (*Albizzia Lebbek*). They are plentiful about the town. Another species (*Poinciana pulcherrima*), nearly related to the sensitive plant (*Mimosa*), also loses its leaves in the winter, but bears pods quite different in appearance. These pods are long, some measuring twenty-four inches, dark-colored, even almost black. A fine group of these trees surrounds the library building. A few vines belonging to this family are interesting, especially the *Abrus precatorius*, or wild licorice. Twining over the tops of the trees, it produces small pods growing in clusters, in which are bright-red seeds with a black spot on one end. These seeds are known to almost all children as Guiana peas or "Black-eyed Susans." They have been extensively used for ornaments in shell work, and it is not uncommon to hear people say they thought they were a kind of shell or some part of one, so associated are they with such work. Then there is the nicker (*Guilandina*), a prickly trailing shrub. We were told that boys take the yellow or olive-colored seeds from the flattened prickly pods and use them instead of marbles for playing games. There are pods of an innumerable variety of shapes and sizes, some that twist in opening, others that curl—in fact, pods of every description are to be found in this region.

The most remarkable tree on the island of New Providence is without quesion a specimen of the silk cotton (*Bombax Ceiba*), situated near the post office and prison. Growing from its trunk are half a dozen buttresslike extensions, as if to make a firm footing for its great spread of branches of one hundred and sixteen feet. A little boy, to whom I showed a photograph of it, expressed its appearance very well when he said the spaces between the buttresses would make fine horse stalls. The pods which grow on the tree contain a soft, silky material which the natives sometimes use for stuffing pillows. There are more of these trees, but none so large or old as this one, and we heard no estimate of its age. It is a near relative of the monkey tamarind. Between this Bombax and the library is an avenue of Spanish laurel, a member of the fig family—untidy and inelegant trees, with a growth of roots hanging from their branches which never reach the ground. We saw in the hospital grounds a specimen of the same family, which is called the wild fig. About three miles from Nassau is another species of fig, errone-

ously called *Ficus indica*, or banyan tree of India. It has the same habit of growth as the banyan, sending down fibers which sink into the soil. These fibers take root, and in turn become parent trunks, shooting out new branches, which in time suspend their roots, and these, swelling into trunks, produce still other branches. All these trees bear fruit, but the figs are small and unfit for eating. *Ficus carica*, the fig of commerce, and the India-rubber tree belong to the same family, and are all characterized by a milky juice. On these islands there are large timber trees, including, among others, the mahogany, mastic, lignum vitæ, etc. Some trees, like the cinnamon, are valuable for their bark; others, like the logwood and fustic, are useful for their dyes. On one of our several pleasant excursions we drove through the pine woods and palmettos to Lake Killarney. Here we saw the only species of pine growing on the island (*Pinus bahamensis*), and along the roadside we noticed the beautiful and conspicuous shrub, the sappens (*Chrysophyllum oliveforme*), with its shining green leaves above, and below a down of rich golden-brown color. The shores of the lake are lined with mangrove trees, which send out aërial roots from their branches. They descend in arched fashion, strike at some distance from the parent stem, and send up new trunks, spreading like the banyan. The south shore of the island is also overrun with the mangrove, the salt water at high tide surrounding many of the bushes, giving a curious effect for miles along the shore.

Other excursions that we took included the bathing beach, the caves to the west of Nassau, and the remarkable Lake of Waterloo, which should be visited after dark in order that its wonderful phosphorescence may be seen. The greatest charm and wonder was a sail of three to six miles to the sea garden. Leaving the sailboat, we stepped into a dory with a glass bottom, through which the mysteries of the deep were as plainly seen as if only at the depth of a pail of water. On the white sand, fifteen or twenty feet below us, we saw coral, sea fans, and sponges, while exquisitely colored fish darted in and out among the waving forms of life.

Several times in the early morning we visited the market, which is of great interest. Here it is not infrequent to see three or four tomatoes, as many onions, and a little piece of garlic arranged together on a barrel head. The sale of two or three such lots constitutes a day's business, for the needs of the people are small. The natives walk from the surrounding country to the city, bringing the fruit in baskets or trays balanced on their heads. The sapodilla is one of the cheapest and most abundant of fruits. The tree is very handsome with its glossy foliage, and freely bears a chocolate-colored fruit about the shape of a peach and as variable in size. These

are usually sold for a few cents, often being placed in small lots upon the ground or sidewalk. Any one wishing to buy a bushel of them, or, in fact, any other fruit, must visit half a dozen places in order to secure the quantity desired. Unripe cocoanuts are highly in favor. After the fluid with which the nut is filled has been drunk, the albumin or jellylike substance is eaten with a spoon. Hence the term "jelly cocoanut." These can not be procured from the tall trees, as the method of gathering the ripe fruit would break those that are unripe. Boys climb the tall, straight trunks and

A Street in Nassau.

throw down the ripe fruit, which does not crack, or it is sometimes allowed to remain until it drops of itself. It is usual to pay the boys by giving them two out of every dozen. Sweet potatoes and yams are used extensively for food, and both are said to contain more nutriment than the common potato. The sugar cane, from eight to ten feet in length, is often seen in the market. A native referring to it will say that he has had a "long breakfast." Bananas, plantains, and oranges are among the most abundant fruits. The banana

and plantain were formerly considered as distinct species, but now the plantain is regarded as a variety of the banana (*Musa sapientum*). The name of the plantain (*Musa paradisiaca*) originated with the Christians in the East, as they thought it to be the forbidden fruit of paradise. The plantain is cooked and eaten as a vegetable, but is not exported to any extent. It is said to be "to the inhabitants of the torrid zone what bread and potatoes are to those

BUYING SWEET POTATOES.

of the north temperate zone," for a pound of plantains contains more nutriment than three pounds of meat.* It is also the most prolific of all food plants known. Humboldt, the German naturalist, calculated that thirty-three pounds of wheat and ninety-eight pounds of potatoes require for their growth the same space of ground as will produce four thousand pounds of bananas. Such a striking statement would seem to need verification, yet the yield is undoubtedly very great. The banana plant rises from fifteen to twenty feet in height, terminated by a tuft of enormous light-green leaves six to ten feet long, which are at first undivided, but are gradually split up by the wind. From the center issues a stalk bearing the fruit, which gradually turns upward, while the stalk itself continues to grow down, and this end is termed the "banana bob." As we are accus-

* Text-book of Tropical Agriculture. By H. A. Alford Nicholls.

tomed to seeing the bunches in shop windows or in the markets, they are suspended in the direction opposite to that from which they grow. The orange, one of the most important of all fruits, and its allied species, lime, lemon, called there "sour," grape fruit, and shaddock, grow abundantly on the islands. The orange tree is the hardiest member of the citrus family, and is raised farther north than most fruits that grow in the tropics. There is a variety known as the sour orange, some plants of which have become wild, and are known as bitter-sweets. They are very juicy, and have a slight acid flavor. We bought fruit of a greenish color, which did not look ripe, and certainly did not taste as agreeable as the rich golden kind we are accustomed to. It is a mistake to say that oranges are no longer raised from seeds, for that is the customary method of propagation throughout the West Indies. The cultivation of the pine-apple is one of the industries of the Bahamas, but they are not grown to any extent on the island of New Providence. The decomposed coral rock of these islands is a favorable soil for their cultivation. They grow singly upon plants which attain an average height of about a foot and a half, and have long, narrow leaves with sharp, serrated edges. Consequently, the men, women, and children working among them are obliged to protect their legs with strong canvas leggings, and their hands with heavy gloves, to which gauntlets are attached. We bought soursops, custard apples, and star apples in the market. Many other fruits that grow on this island were not ripe at the time we were there. They include water-melon, pumpkin, alligator or avocado pear, guava, groundnut or pea-nut, papaw, seaside grape, cocoa plum, cucumber, rose apple, bread-fruit, egg plant, cashew nut, and mammee. Owing to the rapid ripening and decay of these fruits after being picked, it is almost impossible to export them with success. Pineapples, oranges, bananas, and cocoanuts are the principal fruits that are exported; the two latter, with plantains, can be obtained throughout the year. Most of the fruits grow spontaneously, but the breadfruit has been introduced. In 1787 the English Government sent the bark Bounty, commanded by Captain Bligh, to take young trees of the breadfruit from Otaheite to the West India Islands. Owing to the mutiny of the crew, the transfer of the trees was not accomplished till several years later.

One of the first questions we would ask our guide and driver when we saw a new fruit was, "Is it good to eat?" On one occasion, referring to the sailor's apple, he said, "If yer eat it, it'll do yer up"; of another he said, "It'll put yer in yer grave." The seaside grape, sailor's apple, and many other trees and shrubs that grow in barren or exposed places have their leaves standing vertically, so

that less surface is exposed to the direct rays of the sun. The result is that such trees give but little shade, as the light is not interrupted in its passage to so great an extent as it is by the leaves of ordinary

NATIVE TWINS.

trees. In situations where it is necessary for plants to economize their water supply and prevent undue evaporation, they adapt themselves in various ways for this purpose. Some grow thick, leathery leaves; others have a waxlike or hairy coating; and still others, like the cacti, have thick, succulent stems in the place of leaves. Many of our own desert or seashore plants have adopted one or more of these methods.

The soil, though thin, is fertile, but there are no streams of running water on any of the Bahama Islands except that of Andros. The streets of Nassau and the roads of the surrounding country consist of the coralline rock which underlies the soil. They are white and dazzling, and are kept in repair by the Government. The work is done usually by the prisoners, dressed in prison garb of blue and white striped cotton. The coralline rock is porous and looks not unlike the result of volcanic action. In some places the rocky ground is honeycombed with holes three to ten feet deep, called "pot-holes," in which bananas, especially, like to grow. On the deep sides of one hole we saw a luxuriant growth of delicate ferns.

We found the natives very much afraid of a camera, believing

that it was the Evil Eye fixed upon them, so that many a good opportunity for a snap shot was lost by the sudden hiding or covering of the face of the picturesque negro. Sometimes they could be persuaded for a penny or two to grant one's request to "wait a minute." In some cases, discovering that they had been "took," they would ask for a penny indemnity. One day, just as I was about to photograph two little children, the angry mother appeared, severely scolding because some one had not bargained for a penny. The small children are scantily clad with a single garment, while the women wear white calico dresses, white aprons, and bright-colored plaid handkerchiefs tied around their heads under straw hats. They may or may not be barefooted. The homes of these people are picturesque, especially in the village of Grantstown, where the little huts, often thatched with palmettos, nestle among luxuriant tropical gardens, and the cocoanut palms wave above bananas, oleanders, datura, and sapodilla trees. The houses have no glass in the windows, but instead have shutters with bars, which are the only means

NATIVE HUT, GRANTSTOWN.

of closing the windows. There are never chimneys, for the cooking is all done out of doors, a black pot, with legs suspended over a fire of fagots, serving for general use. Men, women, and children speak to travelers, and expect a word of recognition in return. When

we had taken our last drive, my companion gave our driver a small fee, saying that it was because he was such a good botanist, for he really had been able to tell us the popular names of many plants. He laughed, and as he seemed so much pleased, I said, "James, I suppose you know what botanist means?" "Yes," he answered, "I 'spose it's some kind of a good boy."

MIGRATION.

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IT is easy to understand how natural selection may modify organisms for the good of the species, even at the expense of the individuals which, in each generation, make up the species; but it is difficult to understand how this can be brought about by nurture, for, so far as the direct action of the conditions of life is concerned, the species is identical with the sum of the individuals which now exist. No illustration of the law that the adaptations of living Nature are for the good of the species, and that when this comes into conflict with the welfare of the individuals, these are sacrificed, is more simple or more easy to understand than that afforded by some of the phenomena of migration.

The young salmon which is born in a mountain stream is soon impelled, by something in its nature, to journey downward, even for many hundred miles, until it reaches the unknown ocean, where it would discover, if it had faculties for anything so subjective as discovery, that, while it was born in a little brook, it was made for life in the great ocean. It has brought from its mountain home a natural aptitude for eluding all the strange enemies and for avoiding all the novel dangers which it meets in this new world, and it leads an active, predatory life, fiercely pursuing and destroying its natural but hitherto unknown prey; for growing rapidly, and quickly acquiring all the characteristics of the adult salmon, and storing up the intense nervous energy and the muscular strength which will be needed for forcing its way up the rapids in the mountain torrents, for leaping waterfalls, and fighting for its passage, where it long ago darted down with the current. As sexual maturity approaches, some stimulus, which has its origin in the developing reproductive organs, impels it to leave the ocean and, entering the mouth of a river, to journey upward, often a thousand miles or more, to its sources in the mountains.

At this time the king of fishes, as it is well called, is in physical perfection, with few rivals in beauty or strength or fierce energy, or

indomitable courage and perseverance; but its strength is soon fully taxed in surmounting the obstacles and in fighting the rivals which oppose its progress, until at last, worn and thin, torn and mangled by battle, and battered by rocks and whirlpools, with its skin in rags, its fins crippled and bleeding, and its whole body from nose to tail bruised and emaciated, nothing of its kingly nature remains except the indomitable impulse, which no hardship can quench, still urging it upward, until, if any life is left, it at last reaches the breeding ground.

One of the most magnificent species of this kingly genus was so abundant in the Columbia River before canning houses had reduced its numbers, that the town reaches were packed with salmon, while the surface was covered with the drifting bodies of those that had perished in fierce struggles with the crowd; yet there is good authority for the assertion that not a single one ever returns alive from the breeding grounds in the head waters of the St. Cloud. The whole race is wiped out, utterly exterminated, as soon as it arrives at maturity and physical perfection, in order that the perpetuation of the species may be assured. The whole object and end of the beautifully co-ordinated body, which is provided for by such admirable and wonderful adaptations, which is built up so slowly and at so much cost, is rapid and total destruction.

The marvelous instinct which leads the young fish to the ocean, the organization and the habits which fit it for its marine life—all, in a word, which makes of the salmon our ideal of a lordly fish—is worth nothing as compared with the welfare of generations yet unborn.

Scientific men who are not zoölogists are fond of telling us that science has nothing to do with the Why? and is only concerned with the How? and while this may perhaps be true in the ultimate or philosophical sense of the words, it is often easy in zoölogy to discern why an action is performed, while we are very ignorant of the structural conditions under which it takes place.

As all the individual California salmon seem to act alike, and as the young salmon has no parental instruction, it seems probable that everything it does is the result of its structure or of such nurture as this structure provides for; and yet we may safely say that no one now living is at all likely to discover or to predict its migration from the study of its body, although the reason why the migration takes place is obvious.

Whole books, and not a few of them, have been devoted to learned speculations on the nature of the impulse which leads to the migration of birds, and while the subject is most fascinating, the value of the results has not in all cases paid for the labor.

Newton (Encyclopædia Britannica, article Birds) says: "We have here more than enough to excite our wonder, and instead are brought face to face with perhaps the greatest mystery which the whole animal kingdom presents—a mystery which attracted the attention of the earliest writers, and can in its chief point be no more explained by the modern man of science than by the simple-minded savage or the poet or prophet of antiquity. Some facts are almost universally known, and have been the theme of comment in all ages and in all lands. The hawk that stretches her wings toward the south is as familiar to the latest Nile-boat traveler or dweller on the Bosporus as of old to the author of the book of Job.

"The autumnal thronging by myriads of waterfowl of the rivers of Asia is witnessed by the modern sportsman as it was of old by Homer. . . . But there is no need to multiply instances. The flow and ebb of the mighty feathered wave has been sung by poets and reasoned by philosophers, has given rise to proverbs and entered into popular superstitions, and yet we must say of it still that our ignorance is immense."

While this author does not exaggerate either the interest or our ignorance of the life of birds, which goes on in regions that are almost inaccessible and unknown, there is no reason to suppose their migrations are any more mysterious than most biological problems; for the modern man of science is little more able than the simple-minded savage or the poet or prophet to tell how all the co-ordinated faculties of a predaceous animal are so thrown into action by the stimulus of hunger as to lead to the pursuit and capture of prey; yet there is no mystery in the physiology of hunger, for, while there is much we do not understand, we do know that hunger incites actions which are responsive, or adapted for satisfying hunger.

So also it may be possible to make progress in the study of the meaning of migration in spite of our ignorance of the nature of the impulse which excites and determines it; and while I gratefully acknowledge my debt to Newton for the facts, I am not able to agree with him that there is anything distinctively or peculiarly mysterious in the subject.

While there is reason to believe almost every bird of temperate and arctic climates is migratory to some degree, those which simply range over a wider area at one season than at another present nothing notable, and it is only in regions which are almost or quite deserted by birds for part of the year that their migrations attract the attention of students. As many birds which are most valued for food are found in temperate regions for only a short time in the spring and fall, sportsmen and hunters and all who pursue them for food

have been familiar with the habits of the birds of passage from the dawn of history; but most of the best literature on the subject is by northern ornithologists, and the home of the writer has had and still has great influence on opinion as to the meaning and origin of the migratory habit. Scandinavians and Saxons and Anglo-Saxons are home-loving folk, who, in all their wanderings through this world of care, keep a warm affection for the fatherland.

A learned professor in the University of Upsala once wrote a book to prove that the garden of Eden was in Sweden, by the simple argument that no one who knows the delights of that blessed country can believe paradise could have been anywhere else. He showed that the Atlantis of Plato, the country of the hyperboreans, the garden of the Hesperides, the Fortunate Islands, and the Elysian Fields are but faint and imperfect reminiscences of the lovely and favored climes of Sweden, from which the Greeks themselves derived their alphabet, their astronomy, and their religion.

To men of the north, home seems the natural refuge of the birds, and, as much of the literature of migration is northern, the birth-places of common birds have been regarded as their true or natural homes, and while their disappearance in winter has seemed to call for explanation, their return in summer has been looked at as a matter of course, for the intense love of home which many birds have has seemed enough to draw them back as soon as winter is over. It is the "homing" instinct which makes the carrier pigeon so useful to man; and one of the most impressive features of the migratory habit is the definiteness of the journey northward, which often ends in a particular bush or ledge of rocks. Many of our common birds lay their eggs year after year in the same nest, although they spend part of the year in the heart of a foreign country thousands of miles away, and although the surroundings of the chosen spot may have changed so much that it is no longer a judicious selection. A bottle in the branches of a tree at Oxbridge, in England, is known to have been occupied every year, with only one exception, since 1785, by a pair of blue titmice; and on a hill in Finland, well known to tourists as the most northern point in Europe where the sun can be seen at midnight, a nest is said to have been occupied by a pair of peregrine falcons every year since 1736. Many like cases are recorded, and while it is not probable that the birds which visit a nest year after year for centuries are the same, the fact is all the more remarkable if they belong to successive generations.

According to folklore, some of the summer birds hide near home through the winter, and Carus, in his History of Zoölogy, refers to several learned writers who, early in the seventeenth century, quoted from the older literature much venerable authority for the belief

that swallows hide through the winter in holes and in clefts in the rocks, and even under the water.

Many writers on migration have believed, as they have been taught from childhood, that the birds go south to escape the rigors of a northern winter, although little reflection is needed to show that no animals are better protected or more indifferent to changes of temperature, or that, while sea birds are highly migratory, the open waters of arctic seas are little colder in winter than in summer. Nestlings are often killed by exposure, and eggs require a high external temperature, but old birds are, as a rule, indifferent to cold.

When this is recognized, the prevailing belief is that birds leave their homes in search of food, for scarcity is most assuredly an important factor in the origin of migration; but this view of the matter fails to show why, with the whole world to choose from, they do not settle in lands which are habitable the year round.

> "The shuddering tenant of the frigid zone
> Boldly proclaims the happiest spot his own,"

and the return of the birds seems only natural to the Eskimos; but to us who are not Eskimos the wonder is not that anything which can get away should do so, but why the birds pass by so many lovely and fertile regions to seek a home in the barren and desolate ends of the earth; and it is plain that, of the two journeys which make up the migration, the summer visit to northern lands and waters is at least as remarkable and as well worthy of consideration as the journey southward in the fall.

Failure of food in their birthplace is no doubt the chief reason why the migratory birds do not spend the whole year there, and in so far is an explanation of migration, for no animals are better fitted for moving from regions of scarcity to regions of abundance, although they are no more able than creeping things to establish themselves in new lands which are already well stocked with inhabitants; for they are kept within the limits of their natural habitat, like other animals, by competitors and enemies, rather than by physical barriers, although their power to wander and to overcome physical barriers is without a parallel. There are few oceanic islands, however remote, which are not inhabited by land birds descended from lost wanderers, who, finding these spots unoccupied, have been able to establish themselves. The list of North American birds which are occasionally found in Europe is a long one, and stray specimens of the gray plover, whose summer home is the shore of the Arctic Ocean, have been found at the Cape of Good Hope, in Ceylon, in Australia, in New Zealand, and in Tasmania. Most of the wanderers are shore birds which make long migrations, and be-

ing much exposed to storms are often driven far out of their path; but this is not always the case, for the great albatross follows ships across the whole breadth of the South Pacific, or nearly half the circumference of the earth. Many birds seem to make their whole journey by a single flight, for some which are common in the West Indies and in Nova Scotia are almost unknown within the limits of the United States, making the whole journey past our borders by water and probably by a single flight. The bluethroat, which breeds in the northern part of Scandinavia, is so seldom found in Europe south of the Baltic that there seems to be good evidence that it makes its whole journey to its winter quarters in the region of the upper Nile by a single flight.

There is no reason to suppose all migratory birds inherit this habit from a common ancestor, nor that its purpose is always the same, and many birds of prey seem to have acquired it by ranging far in winter in search of food, and by following their prey into warmer regions, to return to their birthplace in the breeding season.

In those cases the birthplace may have been the original home, before the migratory habit was acquired, and scarcity of food the reason why it was acquired; and the influence of scarcity in causing migration is well shown by the occasional or irregular migrations of certain prolific animals which do not ordinarily leave their birthplaces, although, when these become overstocked, migrations take place, just as human colonists go out from thickly settled countries to find new room for growth in foreign lands. From time to time, at irregular intervals, great armies of the smaller and more prolific rodents, which usually spend their lives where they are born, are met on the march from homes where overproduction has exhausted the food; and several of the older American naturalists have described the migrations of our gray squirrel, although the phenomenon has been most carefully studied in the Norwegian lemming, whose remarkable migrations have figured in literature for centuries. The lemming is a small, restless, pugnacious, and very prolific rodent, which at uncertain and irregular intervals of from five to twenty years migrates from its home in the central mountain chain of Norway, and invades the low lands so suddenly and in such numbers that it is still popularly believed, as in the day of Olaus Magnus, who wrote in 1490, to drop from the sky.

The great army of lemmings travels in a straight line and overruns the cultivated country, swimming the lakes and rivers, and causing so much destruction that a special formula to be employed against it was at one time authorized by the Church, which attempted to check its march by exorcism, just as the old Bishop of Montreal tried to drive away the wild pigeons by anathemas. The lemmings

travel at night, but their march is not continuous, for they make long halts in fertile spots, where they are even more prolific than they were at home, so that they become more and more numerous, although they are attended by bears, wolves, foxes, dogs, and cats, and by hawks and owls, and other beasts and birds of prey, and although even the cattle and reindeer are said to kill and eat them. The march may last for several years, but as they never go back, but continue to move forward, they at last reach the ocean, and, attempting to swim this as they have all the rivers in their course, all are drowned.

While the migration of the lemmings is undoubtedly due to scarcity, it is difficult to understand its use, for at the present day the only ones to profit by it are those who have the instinct least developed and stay at home in the mountains, although it may have been useful to the species before the low lands were occupied by man, who now destroys the stragglers and prevents them from scattering and finding permanent homes.

While the determining influence is the scarcity which comes from overcrowding, we have no reason to believe the lemmings consciously and deliberately set out to find a better feeding ground, or that they have traditions of the rich low lands which attract them as the wealth and luxury of China and Mesopotamia and of the Roman Empire attracted the Tartars and Scythians and Goths from the sterile and desolate northern lands into the fertile homes of southern civilization.

Their journeys are no doubt initiated by an unconscious impulse, which, before it brought them into conflict with man, was useful in some way to the species; and this seems to be true of the migrations of certain prolific species of locusts and grasshoppers, which, inhabiting sandy deserts, often overflow the limits of their natural home, and invade more fertile regions where they are not usually found. While there is no reason to suppose these movements are undertaken through deliberate intention to find new feeding grounds, lack of food is no doubt the chief factor in the development of the migratory instinct of rodents as well as locusts, which latter resemble birds in ability to make long journeys on the wing without rest. The African locust has been met at sea in great clouds more than twelve hundred miles from land, and this species sometimes wanders from its home in Africa to England.

While the movements of rodents and locusts show that the search for food has much to do with migration, they lack the features which make the migrations of birds so remarkable. They occur at irregular intervals, while the movements of birds are almost as regular as the almanac, for, while sea birds seem much exposed to storms,

the days of their arrival and departure can be predicted as if they were satellites revolving round the earth. "Foul weather or fair, heat or cold, the puffins make their appearance at the proper day as promptly as if they were moved by clockwork." While the course of the migration of rodents and locusts is determined by conditions so complicated and irregular that they may be called accidental, the northward journey of birds is often directed to a definite spot thousands of miles away from the starting point, and the resemblance between irregular migration in search of food and the migration of birds is too imperfect to tell us much about the origin of the latter, which resembles more the movements of fishes like the shad, which at a definite season enters upon a journey along a definite path to a spot hundreds of miles away, to return again after the purpose of the journey is accomplished.

Since the number of shad which enter a river in the spring is out of all proportion to its resources as a feeding ground, we might say of them, as we are disposed to say of birds, that they leave their birthplace in search of food; but as they find so little food in the rivers that it may be said, with almost literal exactness, that they make their journey fasting, it is quite plain that this is the wrong point of view; that we must believe they enter the river to lay their eggs, and that we must see in this, and not in the return to the ocean, the purpose of the migration.

As the shad is a marine fish which does its eating at sea, and as its visits to fresh water are only for the purpose of reproduction, the numbers which make their way up the rivers are out of all proportion to the capacity of the streams for supplying them with food. The shad enters the mouths of our rivers in the spring in great schools, and travels up them to a most surprising distance; for the total length of the journey from the sea to the spawning ground and back again often exceeds a thousand miles, and this journey is made almost or quite without food. Many of them, and among these the largest fishes, go on until they meet some insurmountable obstacle, such as a waterfall or a dam, or until they reach the head waters of the river. Before dams were built in the Susquehanna, many shad which entered the Chesapeake Bay at the Capes continued their long-fasting journey across Virginia, Maryland, and Pennsylvania into the State of New York, and traveled through more than five hundred miles of inland waters on the journey upward.

Fragments of Indian pottery, stamped with a pattern made by the impression of a shad's backbone, have been found in southern New York, and the number of stone net-sinkers which have been picked up in the Wyoming Valley shows that the Indians had known

and used these fisheries long before the first white settlers found them at work with their rude seines. In the early part of this century, before canals and the dams which supply them were made, there were forty fishing stations beyond the forks of the Susquehanna in northern Pennsylvania, and some of them were worth from one thousand to twelve hundred dollars a year to their owners. There is a record of the capture, at a single haul, of ten thousand shad at one of these fisheries on Fire Island, near Wilkesbarre. Dams across the river have excluded the shad from more than two hundred miles of the course of the Susquehanna, and the profitable fisheries now reach for only a few miles above the boundaries of Maryland, while the shad are cut off from many of the best breeding grounds, which are the sandy flats near the shores of streams and the sand bars which lie in their course. The fishes run up into these places in pairs in the early evening after sunset, and the eggs are thrown into the water while the fishes are swimming about, but they soon sink to the bottom and develop very rapidly. The number of eggs is about twenty-five thousand, but a hundred thousand have been obtained from a single large shad. Few adult shad escape all the dangers of their journey, and these few are so battered and emaciated that they have no value as food, and are unknown in our markets, which are supplied with those that are captured on their way upward. The young fish remain in the rivers until late in the fall, feeding upon small crustacea, the larvæ of insects, the young of other fishes, and minute active animals, and they grow to a length of two or three inches by November, when they leave our waters for the ocean. The shad is a marine fish which has acquired the habit of laying its eggs in fresh water, out of reach of the innumerable enemies that abound on the shoals and sand bars of the seashore. Since the eggs are abandoned by their parents soon after they are laid, prolonged residence at the breeding grounds is not necessary, and the shad has thus been able to utilize safe places which supply no proper food and are unfit for prolonged residence. If it were compelled to incubate its eggs and to guard and protect and feed its nestlings like a bird, it would have been restricted to some breeding place fitted for more prolonged residence, and we should then feel something of the same tendency to call its birthplace its true home that we experience in our study of birds. We should refer the migration to this place as the starting point, and we should try to discover some reason why they spend part of the year elsewhere.

Most animals owe their existence to the occurrence, in their natural home, of all that their life requires, but the power to traverse great distances at great speed, and to pass over all the barriers of land and water, joined to their comparative indifference to changes

of temperature, permits birds to divide their time between widely separated regions, and, whether the choice be conscious or unconscious, the breeding places of migratory birds are selected on account of their safety, and not because they furnish all that a permanent home must supply. If we believe, with Professor Marsh, that the power of flight was acquired by birds after they became arboreal, we must look for the primitive home of the migratory birds in the great tropical and subtropical forests where arboreal reptiles and arboreal mammals still abound; nor can we believe the great armies of northern birds which find abundant food in southern lands in winter are driven out by scarcity on the approach of spring. Enemies are numerous in the tropics, but no animals have sharper senses or better means of escape than birds, and, trusting in their power of flight and their quick sight and hearing, they venture into danger with confidence. The great charm of birds to us is the fearlessness with which they approach man, who is the most dreaded enemy of all other vertebrates; but while adult birds are eminently fitted for taking care of themselves, the opposite is true, in even greater degree, of nestlings, for no animals are at the same time more helpless and more exposed to danger than many young birds, while eggs are not only absolutely helpless but also very tempting to enemies, although there is no group of animals in which the safety of the eggs and young is more important. Among birds a high birth rate is incompatible with flight, for their eggs are large and heavy, and the preservation of each species imperatively demands that every egg shall be cared for with unceasing solicitude; for while, in other animals, increased danger to eggs and young may be met by an increase in the birth rate, this can not be much increased in birds without corresponding loss in the power of flight. Every one knows how quickly birds are exterminated by the destruction of their eggs and young, and the low birth rate of all birds of powerful flight is a sufficient reason for migration, for at the same time that flight limits the birth rate it permits the birds to seek nesting places beyond the reach of their enemies; and as there is rigorous selection of the nestlings which are born in safe nests, it is easy to understand how the instinct has been gradually fixed by selection, and how, as it has become more and more firmly fixed, and as the safety of the eggs and young has become assured by the remoteness and isolation of the nests, the birth rate has been still more reduced and the power of flight correspondingly extended. Many sea birds that nest on desolate rocks in midocean lay only one egg each year, and have the power of flight in its highest perfection. The power of the storm petrel to wander is as boundless as the ocean, and while it lays only a single egg, it is said to be the most prolific

of birds, since the number of individuals is greater than in any other genus.

We can not believe that all migratory birds inherit the habit from a common parent which was migratory, nor is it probable that in all cases it owes its origin to the same influences; but if the view which is here advanced be correct, we must believe that in most migratory birds it has been brought into existence by the needs which are involved in reproduction, and not by the supply of food, and that the winter home of birds in tropical and temperate regions, and not the birthplace of modern birds, must be regarded as the starting point for the migratory habit.

While Wallace was the first to recognize the importance of selection in the formation of this and other instincts, he seems to think selection alone, without the influence of geological change, is inadequate to explain all the facts of migration. He says: "It appears to me probable that here, as in so many other cases, 'survival of the fittest' will be found to have had a powerful influence. Let us suppose that in any species of migratory birds breeding can, as a rule, be only safely accomplished in a given area; and, further, that during the great part of the rest of the year sufficient food can not be obtained in that area. It will follow that those birds which do not leave the breeding area at the proper season will suffer, and ultimately become extinct, which will also be the fate of those which do not leave the feeding area at the proper time. Now, if we suppose that the two areas were for some remote ancestor of the existing species coincident, but by geological or climatic changes gradually diverged from each other, we can easily understand how the habit of incipient and partial migration at the proper seasons would at last become hereditary, and so fixed as to become what we term an instinct. It will probably be found that every gradation still exists in various parts of the world, from a complete coincidence to a complete separation of the breeding and the subsistence areas; and when the natural history of a sufficient number of species is thoroughly worked out, we may find every link between species which never have a restricted area where they breed and live the whole year round to others in which the two areas are absolutely separated."

Modern zoölogy owes its scientific basis to the work of Wallace and Darwin on the distribution of birds, which, in their hands, has led to a revolution in our conceptions of Nature, and has given so much weight to their opinions that no one would venture to differ from them inconsiderately, although when we try to interpret, in the light of his other writings, Wallace's assertion that "the habit of incipient and partial migration" may "at last become hereditary," we must doubt whether he has carefully weighed his words.

We must also remember that distribution and migration are distinct phenomena, and that while the geographical distribution of birds shows clear indications of the effect of past geological changes in the distribution of land and water, migratory birds are kept, like other birds, from invading other provinces than their own by competitors and enemies rather than by geographical barriers.

As so many birds move toward the poles of the earth to lay their eggs, and toward the equator to spend the winter, the view that their two homes have been drawn apart by changes of climate seems probable at first sight, but the rule is not universal, for many of the great breeding grounds of sea birds are in temperate or tropical regions. The petrels, albatrosses, terns, gulls, and many other birds pass most of their life scattered over the ocean, but this affords no nesting place, while the wastes of water which keep carnivorous mammals and reptiles and other enemies of nestling birds from the remote and desolate rocks and sand bars of the open ocean are no obstacle to them. These spots are so secure that birds born in them are much more likely to survive than those born on the shores of inhabited lands, so that it has come about that all or nearly all of the modern members of these groups are descended from ancestors which shunned the dangerous nesting places, not because acquired habits have become hereditary, nor because their feeding ground and their nesting place have been drawn apart by geological change, but because all which did not instinctively lay in safe places the few eggs which are all their fitness for continuous and rapid flight permits, have been exterminated. These birds now gather from all parts of the ocean on the few widely scattered rocks and islands where their young are safe, and the periodic assemblies of innumerable multitudes of wandering sea birds in the "rookeries" are true migrations, for they are as regular as the almanac in the time of arrival and departure, although their feeding ground is almost as extensive as the ocean and the food supply has nothing to do with their movements, and although they do not reach the "rookeries" by a single path.

In this case the needs of reproduction are the controlling influence, and the site of the "rookery" has been fixed by its safety; and while it is difficult to say how far the birds are guided by knowledge of the danger of other places, the well-known tameness of sea birds in their breeding places, and their apparent ignorance of the existence of enemies seem to show that they are quite unconscious of the advantages of the chosen spot, and that they resort to it automatically or naturally not because they know its safety, but because they owe their survival and existence to the fact that it is safe.

Zoölogists are far too ready to resort to the boundless fields for

speculation which geology affords, and it has been gravely suggested that the migration of the lemmings and their death in the waters of the ocean may be due to their efforts to reach the lost Atlantis, where their ancestors dwelt during the Miocene period, although this opinion has no better basis than the belief of Olaus Magnus that they rain down from the sky, where they are engendered from the decomposing exhalations from the clouds impregnated by the semen of rats.

It is easy to understand how birds near the northern limit of their range invade the territory of those whose home is a little farther south, and compete with them for food as this becomes scarce with the approach of winter, and how this movement spreads until all the members of the species are involved, although many of them might have been able to subsist some time longer in their breeding ground if they had been undisturbed.

We have seen that this has commended itself to northern naturalists as a sufficient reason for the acquisition of the migratory habit, and the fondness for their birthplace which is so strongly marked in birds has been thought enough to draw them back; but love of home is itself a result of natural selection, and the necessity for finding safe places for the eggs and young is enough to account for the migration without the aid of geological changes.

While we know little as to the means by which birds find their way over land and water, we know that, as a matter of fact, they are able to do so; and we also know that the instinct which leads them to seek safe places for their nests is so firmly implanted in their nature that centuries of domestication weaken it but little, for it is still almost as strong in the Guinea fowl and the turkey and the hen as it is in wild birds. As birds of powerful flight have a range of choice almost as wide as the earth itself, it is not surprising that the continual destruction of those born in the least safe nests has at last resulted in the survival of the ones which make their nests thousands of miles away from their natural or ancestral home.

While most writers have thought migration had its origin in an annual journey which, while short, was definitely fixed for all the members of the species, and while they have felt forced to call in the aid of geology to account for the gradual separation of the two termini and the lengthening of the journey, the hypothesis of geological change seems gratuitous and unnecessary, since the known habits and instincts and needs of the birds are in themselves a sufficient explanation of all the broader and more general characteristics of migration. It seems much more simple, and more consistent with our knowledge of the past history of living things in general, to believe it had its origin in an intense but geographically

indefinite impulse which led birds to scatter at the breeding season and to hunt out safe hiding places for their nests; and that, as enemies also improved in power to find the most accessible nests, the instinct has been gradually shaped into definiteness by extermination and natural selection, until at last safe breeding grounds, far away from home and far out of the reach of natural enemies, have become established, and until many species and all the members of each species have come to share the impulse to resort to the selected breeding places on the approach of sexual excitement, and to follow the same path between distant points; that the increasing safety of the eggs and young has permitted a low birth rate and the improvement by selection of the power of rapid and long-continued flight; and that this has in its turn permitted the migration to become longer and longer, and more and more protection to the eggs and young.

The history of migratory birds has been long and complicated, and there has been time for great changes in climate and in the distribution of land and water, and these have no doubt left some permanent impression on the habits of birds. The birds have not eluded all their enemies, for predaceous birds and their prey are found together at both ends of the journey. New ways to escape enemies and new ways to find food are as important as they ever were, and the details of the subject are very complicated, although it seems clear that its broader outlines admit of explanation without recourse to geological changes or the inheritance of the direct effects of the conditions of life.

In conclusion, I wish to remind the reader that our present interest in migration lies in its value and simplicity as an illustration of the general law that the adaptations of Nature are for the good of the species and not for the benefit of the individual.

This law is universal, but since the welfare of the species is usually identical with that of the constituent individuals, it is not obvious unless the good of the species demands the sacrifice of individuals.

Long journeys are hazardous. Every California salmon which enters on the long journey to the breeding ground is destroyed, and the whole race of adult fishes is wiped out of existence, for the good of generations yet unborn. Few shad ever return to the ocean, and storm and accident and ruthless enemies work their will on the migrating birds and decimate them without mercy, although the dangerous return to the safe breeding grounds still keeps up, in order that children which are yet unborn may survive to produce children in their turn.

The safeguards which Nature throws around eggs and infants and the immature, and the indifference to the fate of the mature ani-

mals which is exhibited by the influences that have modified species into fitness for their environment, are facts which must never be lost sight of, for if we forget them our attempts to understand the history of the properties of living things are certain to mislead us and to end in failure.

PRINCIPLES OF TAXATION.

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XVII.—THE CASE OF KIRTLAND *vs.* HOTCHKISS.

THE above designation has been popularly given to one of the most important questions that has ever come before the legal tribunals of this country, and the record of which has been heretofore so difficult of access that it has not attracted the attention it merits, but which it is to be hoped will prove at no distant period a subject of popular interest and future judicial consideration.

The particulars of the case are in the main as follows:

In 1869, or previous, Charles W. Kirtland, a citizen of Woodbury, Litchfield County, Connecticut, loaned money, through an agent, a resident and citizen of Illinois, on bonds secured by deeds of trust on real estate in the city of Chicago. Each of these bonds declared that "it was made under and is in all respects to be construed by the laws of the State of Illinois," and that the principal and interest of the obligation were payable in the city of Chicago. The deed of trust also contained a provision that all taxes and assessments on the property conveyed should be paid by the obligor (borrower) without abatement on account of the mortgage lien; that the property might be sold at auction, in Chicago, by the trustee, in case of any default of payment, and that a good title, free from any right of redemption, on the part of the obligor, might in that case be given by the trustee. Another interesting feature of the case not to be overlooked was, that pending the proceedings to be next related, the loans as originally made became due and were paid; when the proceeds, without being removed from Illinois and returned to Mr. Kirtland in Connecticut, were reinvested in Chicago by his agent, under terms and conditions as before.

These facts becoming known to the tax officials of the town of Woodbury, they added in 1869 to the list of property returned by Kirtland for the purpose of taxation, as situated within the State, the sum of eighteen thousand dollars; and in 1870 the sum of twenty thousand dollars, to represent the amount of property owned and

loaned by Kirtland, in each of these years, as was conceded, without the territory of the State. The sums thus added were subsequently assessed in the town of Woodbury in the same manner and at the same rate as was other property which Mr. Kirtland owned within the State and there situated.

Payment of the taxes thus assessed on the amount of these Illinois loans being refused by Kirtland, the tax collector (Hotchkiss), in April, 1873, levied his tax warrants on the real estate of the alleged delinquent in Woodbury, and advertised the same for sale; and on petition for injunction to restrain the collector from such proceedings, on the ground of the illegality of the tax in question and its assessment, the case came before the court of last appeal in the State, known as the "Supreme Court of Errors"; it being agreed by all parties concerned that the only question in the case was whether the bonds owned by Kirtland, drawn in the form and manner stated, were liable to taxation in Connecticut.

Case for the Respondent.—In the argument before and in the opinion rendered by this court the following were the points mainly relied upon in support of the position that the petition for injunction in restraint of the collection of the tax should not be granted: *First*, that the statutes of Connecticut explicitly authorized and required the taxation of debts due its citizens from parties out of the State. *Second*, in respect to the power of the Legislature of Connecticut to authorize and require such form of taxation, it was claimed that there was no provision in the Constitution of the State limiting and defining such power of taxation. *Third*, the following characterization of the nature of a debt or a chose in action, and its suitability as a subject for taxation for the purpose of obtaining revenue, was put forward by the counsel for the State as a statement of economic conclusions worthy of full acceptance. "It (a chose in action) has not a visible, tangible form. The note, bond, or account even, may be evidence of a debt, but it is not the debt itself. The specific money when loaned, and received by the borrower, is no longer the property of the creditor. It is soon merged in the circulating mass, and the creditor can neither identify and claim it, nor put his hand upon any property purchased with it, and say that that is his. The money may be invested in real estate, or manufacturing, or mechandising, or speculation. It may prove a profitable investment, or it may in a short time prove a total loss. It is all the same to the creditor so long as his debtor's ability to pay is unimpaired. He has simply a right to receive a given sum of money with interest or damages for its detention. It is a personal right, and accompanies the person of the creditor. The debtor is under a corresponding obligation to pay the demand. The right to receive is

valuable, and through it an income is derived. *That right may with propriety be taxed.* The obligation to pay is a burden, and has never, to our knowledge, been the subject of taxation. It seems, therefore, that the appropriate place to tax money at interest is where the creditor resides, and that for that purpose it may with propriety be said to be located with the creditor." *

The respondent attached much importance to the analogy "between a money demand, evidenced by a note or bond, and shares of stock in a corporation"; and to the fact that the United States Supreme Court had decided that shares of stock in national banks are property, separate and distinct from the property of the corporations which they represent, and are taxable" (National Bank *vs.* Commonwealth, 9 Wall., 353).

Reference was also made to the case of Minot *vs.* The Philadelphia, Wilmington & Baltimore Railroad Company, in which the United States Supreme Court was held to have recognized a distinction between shares of railroad stock and the capital (property) of a corporation, and in respect to which it was assumed that the court maintained that the share of a stockholder is something different from the capital stock of a company; the latter being the property of the company only, while the former is the individual interest of the stockholder, constituting his right to a proportional part of the dividends when declared and to a proportional part of the effects of the corporation when dissolved after payment of its debts. Regarded in that aspect, it was held to be an interest or right which accompanies the person of the owner and having no locality independent of its domicile.

But whether, when thus regarded, it can be treated as so far separable from the property to which it relates as to be taxable independent of the locality of the latter, was a question which the counsel of the State did not hold to be decided; but there was a strong intimation that the United States Court intended to decide that shares of railroad stock can only be taxed in the State where the owner resides.

Case for the Petitioners.—On the other hand, the following is a summary of the arguments and reasons advanced (mainly by one of the most learned and distinguished members of the Court of Errors of the State, and of the American Bar, Hon. L. F. S. Foster, formerly president of the United States Senate and acting Vice-President of the United States), in support of the petition for an injunction in restraint of the collection of a tax upon the plaintiff:

* Reference in this connection is made to the opinions on this general subject expressed by the Supreme Court of California, given in chapter xvi, Popular Science Monthly, pp. 651–653.

"Taxation and protection are correlative terms. Protection to the person is the ground on which the right to tax the person rests. Protection to the business, protection to that portion of the property not taken by the tax, is the consideration or compensation for all legitimate taxation on business or on property. The person must be domiciled within the State to be subject to a personal or poll tax; the business or the property must also be within the territory of the State to confer jurisdiction over them. That the person of the plaintiff is within the jurisdiction, and subject therefore to the taxing power, is apparent from the record. This tax, however, is not imposed on the person; it is imposed on the property of the plaintiff, and as such it must be sustained, if sustained at all. The case does not require any description of the various species of property, real, personal, etc. Real property has, of course, an immovable *situs*, and can never be subject to any taxation except that imposed by the government within whose jurisdiction it is situate. The reason is, that that government is the only one that can afford it protection. Personal property, of whatever it may consist, though capable of being transported from place to place, if it be of a visible and tangible kind, would seem, in the nature of things, to follow the same rule and for the same reason—that is, to be subject to taxation by the State within whose jurisdiction it is situate, as that State only has dominion over it, and as that State only can afford it protection.

"Now, if the property in question be considered real property, it being in the State of Illinois, any tax upon it by Connecticut would be extraterritorial and void. If it be considered personal property, of a visible and tangible character, it is still in the State of Illinois, and so just as much out of the dominion and beyond the jurisdiction of the State of Connecticut as though it were real property. If we consider the property to be an interest in real or personal property, or a title, inchoate, equitable, or legal, to such property in Illinois, such interest, or such title, is no legitimate subject of taxation in Connecticut. The *corpus* and *situs* of this property being in Illinois, and subject, of course, to taxation there because within her jurisdiction, no interest in it, no title to it, can be taxable in Connecticut. Such a claim involves one of two absurdities: either that the same property may be in two places at the same time, or that two independent governments can have jurisdiction over the same subject-matter at one and the same time.

"But the property of the plaintiff on which this tax has been imposed is not real property, nor is it personal, of the character here considered. It may be well to describe it precisely, that there may be no room for misunderstanding.

"The plaintiff loaned money in the city of Chicago, in the State

of Illinois, on bonds conditioned for its repayment, and secured by deeds of trust. One of said bonds, and one of said deeds, as a specimen of all, is made part of the record. This bond declares 'that it is made under, and is in all respects to be construed, by the laws of the State of Illinois, and is given for an actual loan of money [$3,000] made at Chicago, by Charles W. Kirtland [the plaintiff], to Edmund A. Cummings [the obligor] on the day of the date hereof' [July 17, 1869]. The deed of the same date is a conveyance in fee, by Cummings and his wife, of a lot of land in Chicago, to Norman C. Perkins, of said city, to be held by him in trust, as security for the payment of said loan, with power to sell and convey the same, and apply the proceeds in payment of the loan, in case of default on the part of said Cummings to perform the stipulations of said bond. It is quite obvious that Cummings has incurred a debt to Kirtland, and that Kirtland has a claim against Cummings. Cummings is the debtor, Kirtland the creditor. Has this debt a *situs?* If it has, where is it? In Illinois, or in Connecticut? The contract to loan was made in Illinois, there the creditor parted with his money, there is the property pledged for its repayment, there the debtor is domiciled, there the trustee.

"This seems to indicate Illinois as the *situs* of this debt. So far as it is a thing having a substantial existence, it is there, and not elsewhere. The Connecticut statute provides in terms, 'that money secured by mortgages upon real estate in this State shall be set in the list and taxed only in the town where said real estate is situated.' This manifestly recognizes the *situs* of the property pledged as security for a debt, as the *situs* of the debt. But a debt has no *situs*. Only a material thing can have a *corpus*, and only a *corpus* can have a *situs*, for it is the location of the *corpus* that constitutes a *situs*. A debt is neither visible, tangible, nor ponderable; it has no *situs*, no *corpus*. It is a misnomer to call it property. In legal phrase it is but a *chose in action*, a *jus incorporale*. It is an equitable title in the property of the debtor, and it adheres, as a title, in the property it represents. It does not follow the person of the owner in his domicile, though he may transfer it there.

"These views are fully sustained by the United States Supreme Court, in the case of Brown *vs.* Kennedy, 15 Wall., 591.*

* In this case, which covered a proceeding under the confiscation act of 1862, the United States Court rejected the theory that a credit has a legal *situs* where the owner resides, and held that a bond and mortgage form of credit could be confiscated by the United States where the mortgage debtor resided, though, in point of fact, the bond and mortgage were never in the State of Kansas where the proceedings in forfeiture took place, and were, in fact, in possession of the owner, in the rebel lines, in the State of Virginia. The court accordingly passed a decree, and ordered that the said bond, mortgage, and credit be condemned and declared forfeited to the United States. The decree also ordered

"The same court also held to similar conclusions in a number of other cases. Thus, in the case of Pelham *vs.* Rose, 9 Wall., 103, a note, the evidence of the credit, not the credit itself, was the thing proceeded against. In the case of Pelham *vs.* Way, 15 Wall., 196, where the court also held that the proceedings, not having been against either the debt or credit, but only against the material evidence of it, and that material evidence having been out of the marshal's jurisdiction, no confiscation had been effected.

"Now, if these decisions," said Judge Foster to his colleagues in the Court of Errors, "are to be recognized as law, how can it be claimed that on this credit, given by Kirtland to Cummings in the State of Illinois, secured by a deed of real estate there situate, held by a trustee resident there, the debtor being domiciled there, the debt made payable there, the laws of Illinois by express agreement to govern the contract; how (for the question bears repeating) can it be claimed that there is any subject-matter within the jurisdiction of Connecticut on which to impose a tax?

"That the land in Illinois which is the security for this debt, and of which this debt is the representative, has borne its full share of taxes without diminution on account of this debt is not denied. If the land were in Connecticut, this would suffice; no tax could be collected on the debt. That the land is in Illinois can not affect the principle. If each State has dominion over the property, real and personal, within its territory for the purposes of taxation—and he must be a bold man who denies it—that dominion must, from its nature, be exclusive. No other State can have concurrent jurisdiction. Nor does any other State become invested with the power to tax, if the State in which the power is vested omits to exercise that power. Should a State exempt the property, real or personal, within its limits, belonging to non-residents, from taxation, by what authority could any foreign State impose taxes on such property? The question is purely jurisdictional, and the matter of double taxation is not involved. The point is not whether the State may tax a thing

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Kennedy, one of the obligors and mortgagors, to pay the debt into the court, for the use of the United States; and in pursuance of the decree the payment was made to the officers of the court. After the termination of the war, or in 1868, Brown, the obligee and mortgagee in this bond and mortgage, having obtained a pardon from the President of the United States, filed a bill in the United States Circuit Court for the district of Kansas against Kennedy and wife, for the foreclosure of this mortgage. The principal defense was, that the mortgage and the debt secured by it had been confiscated under the act of Congress. That, of course, put in issue the validity of those proceedings. It was admitted as matter of fact and agreed, that Brown, the complainant, was and always had been a resident of Virginia, had been a continuous resident of the State from June, 1860, to September, 1865, and neither the bond nor mortgage in question was during any part of that time in the district of Kansas.

twice, but whether there is anything within its jurisdiction that it can tax at all.

"Resort must be had to a legal fiction to draw this debt into Connecticut. It does not appear from the record that even the evidences of the debt, the bond and deed, were held in Connecticut."

Under such circumstances, it is curious to note, as Judge Foster especially pointed out, to what a singular and absurd hypothesis and procedure the Connecticut authorities, as if conscious that they had abandoned reason and were dealing with sentiment, had recourse in order to get a basis and a warrant for their action. They first assumed that there was an imaginary property, separate and distinct from the material property; and then gave to such imaginary property an imaginary *situs*, thus "going far into the domain of the sentimental and spiritual for the purpose of taxation." Bishop Berkeley, it will be remembered, held to the opinion that matter does not exist, and that we only imagine that it exists; but it is not at all probable that he ever hoped, when alive, that his views would be so practically indorsed, and at so early a day, in the State of his literary adoption. He would have made, moreover, a desirable tax assessor and tax collector under the present Connecticut tax laws; for being logical, even if he was sentimental, he would doubtless have been willing to take the taxes in the pure product of the imagination. His successors, however, were not only sentimental but illogical; for, not content with assuming that the imaginary is the real, they tried to do what the good bishop never would have sanctioned—namely, take something out of nothing.

But apart from these curious and novel politico-economic and legal features, this Kirtland case involves constitutional questions of the highest interest and importance—as much so, perhaps, as any case ever brought to judicial arbitrament since the formation of the Federal Constitution.

The power of the State to tax the business of loaning money, like the power to tax any business transacted within its limits, by way of license or otherwise, whether the money be loaned to parties within or without the State, is unquestionable.

But this, however, can not be exercised by a State when the business is done without the State, though it be done by citizens of the State. Citizens of Connecticut transacting business in Illinois must, therefore, be subject to the laws of Illinois, and not to the laws of Connecticut. Again, if each State of the Federal Union has dominion over the property and business transacted within its territory for the purpose of taxation, that dominion must from its very nature be absolute and exclude the dominion of any other State over the same property and business. Again, the sovereignty of coequal

States involves a full recognition of the dominion and sovereignty of all sister States; and hence section one, Article IV, of the Federal Constitution requires that "full faith and credit shall be given to the public acts, records, and judicial proceedings of other States." Each State, then, in entering the Federal Union, entered into a contract of non-interference with the dominion and prerogatives of other States; and it will not be disputed that the power of taxation is an incident of sovereignty or dominion. The dominion, therefore, of one State for the purpose of taxation over persons, property, business, or the incidents of business, must exclude the dominion of other States over the same persons, property, business, and incidents of business at the same time. Neither in constitutional law in the United States nor in mathematics can the same property, persons, business, or incidents of business occupy two places and two sovereignties at the same time. Hence, the taxation by Connecticut of credits, choses in action, bonds, notes, book accounts, verbal and other contracts, the incidents of actual business transacted in Illinois, must be in legal effect extraterritorial taxation of such business, and so an infringement and violation of the sovereignty of Illinois; or else it must be assumed that business does not include its incidents, or the whole its parts.

Furthermore, if Connecticut has the power of taxing extraterritorial contracts for the loan of money, she has the power to fix any rate and to discriminate as to the States upon whose citizens the burden shall fall; or she may adopt a rate that shall be prohibitory on contracts made by her citizens with citizens of designated States, or citizens of all the States, as her caprice may dictate.

And in this way she may obstruct and to a great extent prevent interstate commerce, which the United States Supreme Court in repeated instances (since the Kirtland case) has decided that the separate State governments can not under the Federal Constitution do either directly or indirectly.

From these considerations, reasoning, and precedents the conclusions of Judge Foster would seem to have been incontrovertible—namely, that "the plaintiff," Kirtland, "was not liable to taxation" in Connecticut "for debts owing to him in Illinois"; and inferentially that, although possibly warranted by the letter of the statute, the act was an attempt on the part of Connecticut to exercise extraterritorial dominion over persons, contracts, or business, and was, therefore, unconstitutional and void. It would also seem to be clear that if property in action (choses in action) is made by fiction of law an *entity*, having a *situs* in one State separate from the property which it represents in another State, an opportunity for the grossest inconsistencies will be perpetrated, and the most

inharmonious, arbitrary, and capricious tax laws and other laws will be enforced by conflicting legislation of States, required by constitutional obligations to "give full faith and credit to the public acts of other States."

The Connecticut Court of Errors, however, dissolved the injunction and dismissed the petition, Judge Foster alone out of a full bench of five dissenting. An appeal being next taken to the United States Supreme Court, the latter (in 1879) affirmed the judgment of the Connecticut court, the essential points of the opinion rendered by Mr. Justice Harlan being as follows: "The debt which the plaintiff, a citizen of Connecticut, holds against the resident of Illinois is property in his hands. The debt, then, having its *situs* at the creditor's residence, and constituting a portion of his estate there, both he and the debt are, for purposes of taxation, within the jurisdiction of the State. It is, consequently, for the State to determine, consistently with its own fundamental law, whether such property owned by one of its residents shall contribute, by way of taxation, to maintain its government, and 'its discretion in that regard is beyond the power of the Federal Government to supervise or control, for the reason that such taxation violates no provision of the Federal Constitution'; as manifestly it does not, as supposed by counsel, interfere in any true sense with the exercise by Congress of the power to regulate commerce among the several States; nor does it, as is further supposed, abridge the privileges or immunities of citizens of the United States, or deprive the citizen of property without due process of law, or violate the constitutional guaranty that the citizens of each State shall be entitled to all the privileges of citizens in the several States.

"Whether the State of Connecticut shall measure the contribution which persons resident within its jurisdiction shall make by way of taxes in return for the protection it affords them, by the value of the credits, choses in action, bonds or stocks which they may own (other than such as are exempted or protected from taxation under the Constitution and laws of the Unted States) is a matter which concerns only the people of that State, and with which the Federal Government can not rightfully interfere."

It remains but to indicate the legitimate deductions and consequences of this decision, and point out some of the circumstances pertinent to the treatment of the case when it was before the United States Court.

In the *first* place, it decided that debts are property; a legitimate deduction from which is that the creation of debts creates property, and the extinguishment or payment of debts annihilates property; a conclusion which has not received the sanction of the judiciary, or

found a place in the tax system of any country other than the United States. *Second*, the decision next gave a miraculous power to residence, by making it capable of producing property out of nothing. *Third*, it sanctioned the right of a State to subject its citizens to double taxation in respect to one and the same property, and indorsed the justice and morality of the act. If the *situs* of the property—in the sense of an actuality—and the owner of a mortgage upon it, are within the territory of one and the same State, and the actuality is fully taxed by it, the separate and duplicate taxation of the mortgage would not be sanctioned except at the demand of the debtor, and which, as equivalent to his asking that the burden of his debt be augmented, he would be not likely to make. But when the actuality and the mortgage are in different States of one and the same nation, as was the situation in the Kirtland case, a different rule is held to prevail, whereby that which in one State was regarded as an incident of property, and as such properly exempt from taxation, becomes by mere transference to another State actual property, and so rightfully subject to taxation.

Fourth. If debts are property, and rightful subjects for taxation, the sphere of the application of this principle should not be restricted to debts created by a mortgage, but should embrace every form of indebtedness created by the loan of capital—as promissory notes, book credits, and policies of life insurance—which are valuable to just the extent that they represent the indebtedness of the company issuing them to the holder of the policy. But if all the forty-four States of the Federal Union or the different countries of the rest of the world were to undertake to pursue capital in the form of debts due their respective citizens for the purpose of taxation, the resulting inextricable and disastrous confusion would be almost beyond the power of imagination.

Fifth. The United States Supreme Court held that there was nothing in the form of taxation involved in this case that interfered with the power of the Federal Government to regulate interstate commerce; but if, as was further held, there was no constitutional limitation on the exercise of the power of taxation by the State of Connecticut, and that the Federal Government can not rightfully interfere with the measure of taxes that a State may impose on credits and choses in action that its citizens may own, it is difficult to see why Connecticut might not impose such taxes on all extraterritorial contracts of pecuniary value as would greatly impair or altogether prevent the commercial intercourse of her citizens with the citizens of other States. Finally, nothing more clearly exhibits the anomalous issues involved in this case than the fact that it could not have come up before any of the courts of England, France, Bel-

gium, Germany, Switzerland, Italy, or Lower Canada; for in none of these countries are debts regarded in the light of property, subject to taxation.

The following facts pertinent to the history of this case are also worthy of record: When the appeal from the decision of the Connecticut Court of Errors was made to the United States Supreme Court, one of the most distinguished members of the bar of the State of New York, and who in repeated instances had commanded the respect and attention of the former court, was moved, through his abstract interest in the legal and economic principles involved in the case, to volunteer his services for its future argument and presentation to this high and final tribunal. But on the day assigned for its hearing, serious illness prevented his attendance on the court, and the case in question went before it practically without verbal argument, and mainly on the presentation of a brief. Some years after the decision was rendered, the then chief justice of the court (the late Morrison R. Waite) told the writer, in a familiar interview, that he had no recollection of the case, and expressed much interest in a presentation of the economic points involved in it.

Another fact especially worthy of the consideration of those who have been instrumental in enacting and defending statutes in respect to taxation in the United States which find no justification in economic principles, or any parallel in the laws or fiscal systems of other countries of high civilization, is, that since the final decision in the Kirtland case, the State of Connecticut, where it originated, has derived no material advantage from it. Nay more, a somewhat extensive inquiry made of its tax officials renders it doubtful if a single extraterritorial mortgage has since been made subject to taxation as property in the form of a debt in the State of Connecticut. And the same is generally believed to be true of a vast number of mortgages of real estate—especially of farming lands of the Western States of the Federal Union—which in recent years have been negotiated and sold by the large number of the so-called "loan and trust companies" in the Eastern States. The fact is, the American people, whose interests have called their attention to this form of taxation, regard it as unequal and unjust, and so clearly in the nature of double taxation on one and the same person and property, and an exaction, that evasion of it is clearly warranted; the whole record of experience under it constituting another demonstration of the fact that under a popular form of government any law regarded as unjust or unnecessary can not be efficiently executed; and to avoid the necessity of evasion it has now become almost the universal practice, in executing mortgages in the United States, that if the mortgage is made subject to taxation the mortgagee shall pay the taxes in addi-

tion to the interest on the loan of capital represented by the mortgage.

NOTE.—In addition to what may be termed the historical elements of this celebrated case, the more strictly legal features of it, as set forth subsequent to the action of the United States Supreme Court, are here pertinent and worthy of consideration:

No. 1. This case seems from its very nature to involve questions of conflict of State dominion. It is admitted that Mr. Kirtland, the plaintiff, so far as the question of taxation at issue is concerned, has not been assessed and taxed upon his body, person, poll, or head, or for any substance, the embodiment of labor, and which alone constitutes property, owned or possessed by him within the territory of Connecticut; nor for any business transacted by him within the State. The plaintiff has, however, been assessed and taxed for dealing in money or doing the business of loaning money, by an assessment and taxation of bonds and mortgages made in Illinois—the necessary incidents and evidence of the business of money lending, performed by himself or through a resident agent in the State of Illinois. It is conceded that the loans were actually made at Chicago in the State of Illinois, as the bonds and mortgages taken state that all the business and acts connected with the loaning and reloaning were actually done, from time to time, there, that the obligations were payable there, and that the contracts of loan were strictly Illinois contracts, to be interpreted as valid or invalid and as to their force and effect according to the laws of that State.

The State of Illinois imposes a tax on resident agents making loans in that State; but it is not important to inquire whether in this instance the business of loaning was done through a resident agent or what that State does actually tax, but what she can constitutionally tax by virtue of her dominion and sovereignty. Illinois can undoubtedly tax, if the tax is not discriminating but uniform on residents and nonresidents, all occupations and also all business transacted within her borders. She can tax money dealers or money lenders by license or otherwise, and she can impose stamp or other taxes and to any degree, in her discretion, on all contracts at the time when made within her jurisdiction. No other State has concurrent jurisdiction over any legitimate subject of taxation within her jurisdiction. Her sovereignty in taxation is absolute except as limited by the national Constitution. But the sovereignty of coequal States involves a full recognition of the dominion and sovereignty of all sister States, and hence section 1, Article IV, of the United States Constitution requires that "full faith and credit shall be given to the public acts, records, and judicial proceedings of other States." This is a compact of noninterference in the dominion of other States in matters of taxation or in reference to other subjects of State dominion. The power of taxation is an incident of sovereignty or of dominion. The dominion, therefore, of one State for the purpose of taxation over persons, property, or business, or the incidents of business, must exclude the dominion of other States over the same persons, property, business, and incidents of business at the same time. Neither in constitutional law in this country nor in mathematics can the same persons, property, business, and incidents of business occupy two places or sovereignties at the same time. The taxation by Connecticut of credits, choses in action, bonds, notes, book accounts, verbal and other contracts, the incidents of actual business transacted in Illinois, must be in legal effect extraterritorial taxation of a part of such business, or otherwise it must be assumed that the incident is not a part of the principal. The making of contracts is of itself a business in the strictest sense, nor can any business exist without the power to make contracts written or verbal. Money can not be loaned unless there is a business of lending money, and for the time being the vocation of a money lender. The amount or duration of a business in a State can have no influence on the question of the jurisdiction of the State over the business or the transaction. A State can tax all sales at auction, including the sales of goods in unbroken packages owned by nonresidents and just brought into the State and sold by nonresidents or by resident agents (Woodruff *vs.* Perham, 8 Wallace 123). In New York mere wandering peddlers are taxable on money invested in business in every town in which they peddle. If actually assessed in more than one town the same year the remedy is to appeal to the assess-

ors (Hill *vs.* Crosby, 26 Howard, par. 413). It would seem that business, occasional, transient, or permanent, transacted in a State by a resident or nonresident, by the force of State sovereignty, may be made subject to a uniform rule of taxation.

Extraterritorial taxation can have no force in American jurisprudence. Protection and taxation are correlative terms. Protection to that portion of property not taken or absorbed by the tax is the consideration or compensation for all legitimate taxation, and extraterritorial taxation is therefore a mere arbitrary "taking of private property without due process of law." When property is not protected by the law of a country or of a State and beyond the process of its courts, there can be no power to tax it (this principle is manifestly as applicable to business as to property—Rice *vs.* the United States, 4 Wheaton 246). In the foreign-held bond case, 15 Wallace 319, the United States Supreme Court said that "property lying beyond the jurisdiction of the State is not a subject upon which her taxing power can be legitimately exercised. Indeed, it would seem that no adjudication should be necessary to establish so obvious a proposition. The power of taxation, however vast in its character and searching in its extent, is necessarily *limited to subjects within the jurisdiction of the State. These subjects are persons, property, and business.*"

These admitted facts and the opinions cited indicate that Connecticut is endeavoring in this case to enforce an extraterritorial tax on extraterritorial business, and a further consideration of the subject might here be dismissed, but a more detailed examination may show more clearly the unconstitutionality of this arbitrary exaction.

EFFECT OF THE FOURTEENTH AMENDMENT OF THE CONSTITUTION OF THE UNITED STATES IN RESPECT TO THE ARBITRARY APPROPRIATION OF PROPERTY BY TAXATION OR OTHERWISE.—Another point preliminary to reform, and in respect to which it is important that there should be a clear understanding on the part of the people, is that there is a broad and philosophical distinction between "taxation" and "arbitrary" taking. It is often assumed that a State, because of its sovereignty, may, through form of law and delegated authority, deal with the persons and property of its subjects as it may see fit; and, repugnant as this assumption is to the principles which are assumed to constitute the foundation of all free government, it is not to be denied that previous to the adoption of the fourteenth amendment of the Constitution of the United States in 1868, it would be difficult to show that restraint existed upon the complete sovereignty of the States of the Federal Union over persons and property within their unquestioned jurisdiction; the right to hold a certain class of their population in slavery, and the right to take private property for public purposes without making any compensation, being illustrative of the exercise of such arbitrary powers in the utmost extreme. But since the decision of the United States Court in the Kirtland case, the same court has for the first time given a decided opinion on this subject, unmistakably as follows: "There is no such thing in the theory of our Government—State or national—as unlimited power in any of these branches. The executive, the legislative, and the judicial departments are all of limited and defined powers. There are limitations of power which arise out of the essential nature of all free governments, implied reservations of

individual rights, without which the social compact could not exist, and which are respected by all free governments entitled to the name. *Among these is the limitation of the right of taxation*" (Loan Association *vs.* Topeka, 20 Wallace, 658).

In connection with this general subject, the opinion expressed by Chief-Justice Marshall is also historically worthy of notice. It had its origin in the case of Baron *vs.* The Mayor of Baltimore, in which the city of Baltimore, in the exercise of its corporate authority over the harbor, etc., so diverted certain streams of water that they made deposits of sand and gravel near the plaintiff's wharf, and thereby prevented the access of vessels to it. A writ of error was taken from the judgment of the Maryland Court of Appeals, refusing damages, to the Supreme Court of the United States, on the ground that this decision was in violation of the fifth amendment to the Constitution of the United States, which prohibits the taking of public property for private use without just compensation; the plaintiff contending further, "that this amendment, being in favor of the liberty of the citizens, ought to be so construed as to restrain the legislative power of a State, as well as that of the United States." The court, however, by Chief-Justice Marshall, held that this amendment of the Constitution "*is intended solely as a limitation on the exercise of power by the Government of the United States, and is not applicable to the legislation of the States*"; which was equivalent to saying, viz., that if the several States choose to arbitrarily take or confiscate the property of any of its citizens, there was no higher sovereignty to restrain them.

At the close of the late civil war, however, when it was deemed desirable by Congress to impose some restrictions on the reconstructed States, so as to prevent the former disloyal element of their population, in the event of the contingency of regaining legislative power, from dealing arbitrarily or unjustly with any class of their fellow-citizens who might happen to be obnoxious, the following clause was made a part of the fourteenth amendment, and through its adoption has become the supreme law of the land: "*Nor shall any State deprive any person of life, liberty, or property without due process of law.*"

Now, the force of this amendment obviously depends upon the meaning of the last clause, "*due process of law*"; and it is also clear that "due process of law" does not mean a procedure in conformity with *any* law which a State legislature might enact, or with any provision which the people of a State might put in their Constitution; for if such be the interpretation of this phrase, then this clause of the fourteenth amendment referred to would practically read as follows: "*Nor shall any State deprive any person of life,*

liberty, or property, except in conformity with such laws as it may enact."

The general meaning of the phrase "*due process of law,*" and of the synonymous expression "*law of the land,*" has, however, been made so often the subject of discussion and legal decision as to be in no sense a matter of doubt. Mr. Webster, in the Dartmouth College case, defined these terms as follows: "By the law of the land is most clearly intended the general law, which hears before it condemns, which proceeds upon inquiry, and renders judgment only after trial. The meaning is that every citizen shall hold his life, liberty, property, and immunities under the protection of the general rules which govern society. Everything which may pass under the form of an enactment is not the law of the land." And in commenting on this definition, Justice Cooley, in his treatise on Constitutional Limitations, uses this language: "This definition of Mr. Webster is apt and suitable as applied to judicial proceedings, which can not be valid unless they proceed upon inquiry, and render judgment only after trial. It is entirely correct, also, in assuming that a legislative enactment is not necessarily the law of the land. The words 'by the law of the land,' as used in the Constitution, do not mean a statute passed for the purpose of working wrong. That construction would render the restriction absolutely nugatory, and turn this part of the Constitution into mere nonsense. Due process of law," therefore, continues Judge Cooley, after reviewing the interpretations of various other authorities, means "such an exertion of the powers of the Government as the settled maxims of law sanction, and under such safeguards for the protection of individual rights as these maxims prescribe."

"The very idea of taxation, the very elements of the terms tax —taxation—implies that it is an imposition or levy upon persons or property in due course or order, treating all alike in the same condition and circumstances. The burden of taxation must be equalized by this mode in order to preserve its character. It is in any view taking private property for public use; and it can not be so taken without an equivalent both as to the Government or the citizens. It is not competent for the Government to convert private property to public use, by way of taxation and without compensation, any more than by any other mode."—*Redfield.*

Now, the exact applicability of the fourteenth amendment in restraining the several States in the exercise of their so-called "taxing powers" would appear to be this:

Taxation implies protection. It is held by every authority to be the equivalent for the protection which the Government affords to the property of its citizens. When, therefore, a State (like Connecti-

cut) taxes property, either directly or indirectly, out of its territory and jurisdiction, which it can not protect, and which its processes can not reach, the act is not taxation, but a mere arbitrary exercise of power; not in accordance with any "process of law," and forbidden by the Constitution of the United States, and as involving a principle under the Constitution. Furthermore, the question of restraining a State from the exercise of such arbitrary powers would seem to be one legally within the right of any citizen aggrieved, in virtue of the fourteenth amendment, to carry from the courts of his own State to the Supreme Court of the United States. As another method by which a citizen of a State aggrieved by the imposition of an *ex-territorial tax* might test the constitutionality of the same, the following is also worthy of consideration:

A citizen of Connecticut, for example, taxed on personal property in Illinois, might obtain a writ of *certiorari* in an Illinois court, and raise the question that, inasmuch as personal property is held in law to follow the person, the property in question was not taxable in Illinois. And after the courts of Illinois had rendered an adverse judgment, as they undoubtedly would, the owner taxed for the same property in Massachusetts could obtain a writ of *certiorari* in the courts of that State, and raise the following questions:

1. Want of jurisdiction in respect to the property on the part of the State of Massachusetts.

2. Violation of the Constitution of the United States in denying full faith and credit to the "public acts (tax laws of Illinois) and judicial proceedings" of a sister State.

It needs no argument to prove that under the provisions of the Constitution of the United States, above referred to, both the laws and judicial proceedings of one State are as valid and as much to be respected in another State as the laws and judicial proceedings of the latter State itself. If the courts of Massachusetts, following precedents in that State, should decide that personal property situated beyond the State follows the person residing in Massachusetts, and so disregards the judicial proceedings and public acts of Illinois, a question under the Constitution of the United States would arise, which would give jurisdiction in the United States Court. And as one and the same thing can not occupy two places at the same time, the Federal court must finally decide in which State is the *situs* of the property for taxation in the case presented. The principle involved in this case would seem to be identical with an attempt on the part of a State to convict a citizen for an offense committed beyond her jurisdiction, in respect to which judgment had already been rendered in a sister State, where the offense had been committed.

As further bearing upon this subject, reference is made to the

following judicial decisions: The Court of Errors of New York, some years ago, decided that private property could not be forcibly taken for a private road, even if compensation was made by the party benefited, because the act was the taking property arbitrarily, and not according to due process of law.

The national bank act acknowledges, and the courts of the United States have so held, that a bank has a *situs* and its shares a *situs* where the bank is located, and not where the stockholders reside. The national bank act, therefore, discards the usual State principle of taxation, that personal property follows the owner.

The principle that *two States can not tax at the same time the same property, and that a State can not tax property and rights to property lying beyond her jurisdiction*, has been also affirmed by the Supreme Court of the United States (December, 1868), in the case of The Northern Central Railroad *vs.* Jackson (7 Wallace, 262). The railroad corporation in question, extending from Baltimore in Maryland to Sunbury in Pennsylvania, was the result of the consolidation of four railroad companies, one incorporated by the State of Maryland and three by the State of Pennsylvania. The latter State imposed a tax of three mills per dollar of the principal of each bond issued by said road, which tax the company, at their office in Baltimore, deducted from the coupons of the bonds of said consolidated road held by Jackson, an alien, resident in Ireland.

The court, by Mr. Justice Nelson, decided adversely to the tax, on the ground that the bonds were issued upon the credit of the line of road, a portion of which was within the jurisdiction of the State of Maryland, and that the security, bound and pledged for the payment of the bonds and of the interest on them, embraced the Maryland portion of the road equally with that portion situated in the State of Pennsylvania, respecting which condition of affairs the court used the following language:

"It is apparent, if the State of Pennsylvania is at liberty to tax these bonds, that to the extent of this Maryland portion of the road she is taxing property and interests beyond her jurisdiction. Again, if Pennsylvania can tax these bonds, upon the same principle Maryland can tax them; this is too apparent to require argument. The consequence of this, if permitted, would be double taxation of the bondholder. The effect of this taxation is readily seen: a tax of three mills per dollar of the principal, at an interest of six per centum, payable semi-annually, is ten per centum per annum of the interest; a tax, therefore, by each State at this rate amounts to an annual reduction from the coupons of twenty per centum; and if this consolidation of the line of road had extended into New York or Ohio,

or into both, the deduction would have been thirty or forty. *If Pennsylvania must tax bonds of this description, she must confine it to bonds issued exclusively by her own corporations.* Our conclusion is that to permit the deduction of the tax from the coupons in question would be giving effect to the acts of the Pennsylvania Legislature upon *property and interests lying beyond her jurisdiction.*"

EVOLUTION AND TELEOLOGY.*

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IN the present paper it is not my purpose to discuss the evidence in favor of evolution or the arguments which may be urged against it. This has been done quite thoroughly in our previous meetings at Paris and Brussels. I shall assume evolution as proved, or rather, that it is the only working theory which is competent to meet the demands of modern science. As against the alternative theory of creationism the evidence, I think, all must admit, is overwhelmingly in favor of evolution. I am quite willing to agree with our retiring president, M. le Marquis de Nadaillac, that as yet the theory is not proved by any demonstrative evidence, for the simple reason that, in the very nature of the case, anything approaching an absolute demonstration, at least in our present state of knowledge, is impossible. But, notwithstanding this, even the most skeptical must concede that evolution is a probable theory, and this is all that need here be claimed.

I freely grant that, *a priori*, creationism is quite possible, but is it probable? Science answers "No." As to affording any positive evidence in behalf of the special creation of species, it is absolutely mute, and the negative evidence is of such a character that there are few, if any, serious men of science who are willing to consider it as having any weight whatever. *A priori*, creationism is possible; *a posteriori*, it is so highly improbable as to be practically ruled out of court. Indeed, those who still cling to the theory rely either on negative evidence, which in such questions is never conclusive or satisfactory, or appeal for support of their view to the account of creation given in the book of Genesis. They assume that the Genesiac narrative is to be interpreted literally, whereas all contemporary biblical scholars of note declare that it is to be understood not literally but allegorically. Nor is there anything new in thus envisag-

* Read before the International Catholic Scientific Congress, Fribourg, Switzerland, August 20, 1897.

ing the scriptural record, for it was, as is well known, the view accepted by some of the most illustrious of the Greek and Latin Fathers. The Alexandrine school was almost a unit in favor of allegorism as against literalism.* All are familiar with the contention of the late Bishop Clifford, who regarded the first thirty-four verses of Genesis as a ritual hymn, and as nothing more than a prelude to what follows. Even some of the most conservative of our modern commentators of Scripture freely admit that the history of creation, as unfolded in Genesis, may be understood in an allegorical as well as in a literal sense. From this is manifest how weak is the argument in favor of creationism which is based solely on the Genesiac narrative.

The argument founded on the doctrine of the fathers is of no more weight than that based on Scripture, while that which may be adduced from the teachings of modern biblical research is practically *nil.* Creationism, then, I repeat, is possible, but there is nothing in a reasonable interpretation of Genesis which makes it at all probable, while all the conclusions of contemporary science render it not only in the highest degree improbable, but also exhibit it as completely discredited and as unworthy of the slightest consideration as a working hypothesis to guide the investigator in the study of Nature and Nature's laws.

But this *en passant.* My theme is not evolution, but rather the bearing of evolution on teleology, or the doctrine of the final causes of things. Paley, Chalmers, and the authors of the Bridgewater Treatises laid special stress on the argument from design, and, indeed, the chief object they had in view in writing their books, which were classics in their day, was to exhibit the purposiveness of Nature, to prove that from the evidence of design, which is everywhere manifest in the visible universe, we must necessarily infer the existence of a designer. And so conclusive was the argument, as then framed, that even the most skeptical and those most opposed to revealed truth were forced to admit that the facts of Nature bear witness to the existence and controlling influence of mind in the universe. Voltaire declared, "*Rien n'ébranle en moi cet axiome, tout ouvrage démontre un ouvrier*"; and Hume, in words no less positive, affirmed that "the whole frame of Nature bespeaks an intelligent maker."

With the appearance, however, of Charles Darwin's epoch-making Origin of Species it was at once recognized on all hands that the design argument had to be materially modified if it were any longer to have the slightest validity. As for the exponents of the mechanical school of philosophy, especially those who rejoice in the new-

* See the writer's work, Bible, Science, and Faith, Part I.

fangled name of Monists, they loudly and triumphantly proclaimed that it was all over with teleology, and that it could, without further ado, be relegated to the limbo of exploded theory and fanciful hypothesis. Büchner asserted that "modern investigation and natural philosophy have shaken themselves tolerably free from these empty and superficial conceptions of design, and leave such childish views to those who are incapable of liberating themselves from such anthropomorphic ideas, which, unfortunately, still obtain in school and Church to the detriment of truth and science." * And Haeckel, with his usual dogmatism, writes, "I maintain with regard to the much-talked-of purpose in Nature, that it really has no existence except for those persons who observe phenomena in plants and animals in the most superficial manner." †

The more profound and philosophic men of science did not, however, share the notions of Haeckel and Büchner. They admitted, it is true, that the teleology of Paley and of the authors of the Bridgewater Treatises was no longer tenable, but they did not, therefore, conclude that teleology was completely annihilated. Far from it. Teleology, they said, must be modified so as to meet the demands of modern science and research, and, as so modified, it is stronger, nobler, and more comprehensive than ever before. So thought among others Huxley and Gray, and so think also Wallace, Mivart, and the Duke of Argyll.

"The most remarkable service to the philosophy of biology rendered by Mr. Darwin," writes Huxley in his Darwiniana, "is the reconciliation of teleology and morphology, and the explanation of the facts of both which his views offer. . . . It is necessary to remember that there is a wider teleology which is not touched by the doctrine of evolution, but is actually based upon the fundamental principle of evolution." ‡

America's great naturalist, Prof. Asa Gray, is no less explicit. "Let us," he says, "recognize Darwin's great service to natural science in bringing back to it teleology, so that, instead of morphology *versus* teleology, we have morphology wedded to teleology." *

"The idea of development in all its logical forms," declares the Duke of Argyll, in his late admirable work, The Philosophy of Belief, "is not antagonistic to, but in perfect harmony with, the idea of purpose. Design, from first to last, from its first conception to the attainment of its farthest aims, is, and so far as we know, must be a process of development. That development may be slow, or it may be quick and sudden in its steps. It may be effected in ways widely various, as by outward building or inward growth, but its

* Force and Matter, p. 218.
† History of Creation, vol. i, p. 19.
‡ Page 110.
* Darwiniana, p. 288.

one essential character remains unchanged. It is a peculiar relation of cause and effect operating in time and exhibiting the one essential characteristic of having been directed in the past, and of being continually directed in the present, to some end which is future, the direction being of that nature which we instinctively and accurately call an aim." *

In a recent article on Darwinism and Design, in the Contemporary Review,† Prof. F. C. S. Schiller concludes his interesting contribution as follows:

"We have discussed so far only mechanical theories of evolution. But in itself evolution is not necessarily bound to be mechanical; it is perfectly possible to regard it as the gradual working of a divine purpose. And once we adopt the evolutionist standpoint, it is clear that the argument from design is materially and perceptibly strengthened: (1) Positively, because evolutionism lets us, as it were, behind the scenes and shows us how means are adapted to ends in the gradual process of evolution. This renders easier and more comprehensive the belief underlying all teleology in a power that intelligently adapts means to ends. (2) Negatively, evolutionism greatly weakens the objection to the teleological argument based on the imperfection of existing adaptations. We are no longer compelled to proclaim everything perfect; it suffices that we can find nourishment for the faith that everything is being made perfect.

"If, then, evolutionism strengthens the argument from design, the latter indirectly owes a debt of gratitude to the theories which have led to the general adoption of the evolutionist standpoint. And among these Darwinism stands pre-eminent. Evolutionism was as old as one of the earliest Greek philosophies; but it was not until Darwinism made it a household word that it could force its way into the consciousness of men at large. And as a philosopher who regards evolutionism in some form as affording the most hopeful method of approaching the mystery of existence, I am inclined to hold that when historical perfection has cleared away the mole-hills we have made into mountains, it will be here that will be found Darwin's most momentous and enduring service to knowledge and to mankind."

From the foregoing it would seem that all unbiased minds should be forced to acknowledge that teleology, far from being weakened or completely eliminated from the circle of the sciences, is, on the contrary, demonstrably in a far more impregnable position than ever before. We have, however, to deal with a certain class of agnostics who insist on reducing everything in creation to force

* Pages 145 *et seq.*

† June, 1897, p. 883.

and matter, and all the phenomena which can come under our observation to the action of force on matter, or to the fortuitous clash of atoms and molecules. They wish to eliminate from their discussions all reference to a creative, directive and intelligent Mind, for, as they contend, such a mind is not only unnecessary but is something which is absolutely unknowable and unthinkable. Eliminating mind from the universe means eliminating purposiveness from Nature, and carries with it, of course, the destruction of all forms of teleology.

Herbert Spencer's works, for instance, are remarkable for their undisguised attempt entirely to eliminate all teleological language and eschew all teleological implications. But, strive as he may, the great corypheus of agnosticism is utterly unable, even in the simplest definitions, to find language that does not, directly or indirectly, imply aim and purpose, and, consequently, an intelligent designer. Thus, in his Principles of Biology, he says that "physiology, in its concrete interpretations, recognizes special functions as the ends of special organs; regards the teeth as having the office of mastication; the heart as an apparatus to propel blood; this gland as fitted to produce one requisite secretion, and that to produce another; each muscle as the agent of a particular motion; each nerve as the vehicle of a special sensation or a special motor impulse." *

All this, however, is teleological language of the most pronounced character. It is seen in the word "function," which implies adaptation and, consequently, preparation and purpose; it is seen in the word "end," which here signifies "aim"; it is seen in the word "apparatus"—*ad-paratus*—which means a mechanism contrived for a specific purpose or operation—a means devised for obtaining some special end, for accomplishing something which has been foreseen and intended. Similarly the words "office," "agent," "fitted to," "recognizes," are all teleological, and replete with the idea of mental purpose. In spite, then, of all agnostic philosophy, in spite of all abstractions which would distort the original signification of words, we have in this simple definition of Spencer's words which are positively surcharged with teleology. But they do no more than express what the observer actually sees and what actually takes place in the economy of Nature. In spite, therefore, of all his attempts to avoid teleological terms, Spencer, like others of his school, is forced, by the very nature and structure of language, to employ them and to make use of expressions which indicate aim, preparation, purposiveness; which imply intelligence, foresight, design, a designer.

* Pages 155 *et seq.*

One of the reasons, no doubt, why certain modern philosophers and men of science have made such onslaughts on teleology is to be found in the too common attribution to teleologists of a crude anthropomorphic conception of the Deity. "The idea of a superintending and designing Mind" conveys, it is asserted, "an unworthy idea of a Supreme Being. It lowers the Creator to the level of an artificer."

"But, whether the idea be unworthy or not, it is fair to remember," as a writer in a recent number of the London Quarterly Review pertinently remarks, "that, if Supreme Mind works in Nature, it can only be through such mental characteristics as are recognizable by men that such a mind could disclose itself. The objection demands a loftiness of method which would serve to conceal its intelligence from the intelligent creatures of its hand. But, further, the divine working is not wholly like the human; it is loftier; it is not the process of a mere artificer. Man produces manufactures; the Divine Mind produces growth and development. It thus works in a fashion more majestic than man's. This conception of the difference between divine and human working does not dissipate the impression that mind works in Nature. There is a distinction in man's workmanship between the mental conception and mechanical execution. This is a real and constant distinction. In Nature this distinction disappears, but the important question here is, Is the conceiving mind lost in the mechanical artificer? This is precisely what does not happen. In the slow, orderly, and well-directed processes of Nature it is the lower—the artificer—action which vanishes; the evidence of the ruling mind remains unimpaired. The objection, therefore, rests on an incomplete analysis. It confounds the high functions of a conceiving mind with the far lower functions of a mere executive mechanic." *

Another reason for the prevalent confusion of thought regarding the relation of teleology to evolution arises from erroneous notions entertained by so many respecting the true signification of creation and evolution. They fail to distinguish between absolute creation *ex nihilo* and derivative creation. Absolute creation embraces only spiritual intelligences and the material elements of which the universe is composed. Derivative creation, on the contrary, means only the formation of something from pre-existing material, and includes all organic and inorganic compounds, all forms of vegetable and animal life, for all these have been produced from those elementary bodies which constitute alike the earth and all the orbs of the firmament. Only absolute creation, therefore, is creation properly so called. Derivative creation, however, is

* July, 1896, p. 218.

nothing more than development under the action of the laws of Nature imposed by God on the elements in the beginning. It is evolution from lower to higher forms under the action of what St. Thomas calls the Divine Administration, and in consequence of the action of what St. Augustine terms seminal reasons—*rationes seminales*. Absolute creation is direct, immediate, supernatural; derivative creation is indirect, and is effected by the Almighty through the agency of secondary causes. In the beginning God created the elements once for all, but on these simple elements he conferred the power of evolving into all the countless forms of beauty which now characterize the organic and inorganic worlds. What, then, the older theologians called secondary or potential creation or formation —development under the guidance of God's providence—we may now call, and with the utmost precision of language, evolution. For God, as St. Augustine observes, did not create animals and plants directly, but potentially and causally—*in fieri, in causa; potentialiter atque causaliter*. This, however, is theistic evolution, not agnostic evolution which relegates God to the region of the unknowable; nor atheistic evolution which finds in the chance interaction of eternal force and eternal matter an adequate explanation of all the problems of the existing universe. For, let me insist, evolution does not and can not account for the origin of things. The best it can do is to throw some light on their historical development; and this for the simple reason that it does not and can not deal with the origin of things, but only with the *modus creandi*, or rather with the *modus formandi*, employed by Omnipotence, after the universe had been called into existence by divine *Fiat*. "Evolution, then," as I have elsewhere shown,* "postulates creation as an intellectual necessity, for if there had not been a creation there would have been nothing to evolve, and evolution would, therefore, have been an impossibility.

"And, for the same reason, evolution postulates and must postulate a Creator, the sovereign Lord of all things, the Cause of causes, the *terminus a quo* as well as the *terminus ad quem* of all that exists or can exist. But evolution postulates still more. In order that evolution might be at all possible, it was necessary that there should have been not only an antecedent creation *ex nihilo*, but also that there should have been an antecedent involution or creation *in potentia*. To suppose that simple brute matter could, by its own motion or by any power inherent in matter as such, have been the sole efficient cause of the evolution of organic from inorganic matter, of the higher from the lower forms of life, of the rational from the irrational creature, is to suppose that a thing can

* Evolution and Dogma, pp. 431, 432.

give what it does not possess, that the greater is contained in the less, the superior in the inferior, the whole in a part."

Still another difficulty for the opponents of teleology arises from their inability to understand the purpose of many things in Nature. This, however, far from being an objection to the argument from design, should only make one more conscious of his ignorance, and of the limitation of human knowledge. If we can discern manifest evidence of design—and this no reasonable man can deny—in even a few things, and if, of the manifold purposes exhibited in any given object, we can discover but one, we have evidence which is quite sufficient for the validity of the design-argument, and quite sufficient, likewise, to meet all the requirements of the teleologist.

It is, indeed, passing strange that those who are always so prompt to deny the existence of purpose in Nature, when there is question of teleology, or when theological implications are suspected, are the very first to insist on the evidence of mind and purpose when in their own case it is demanded by the exigencies of argument or discovery, and especially when it is demanded by the exigencies of special pleading.

A case in point is the argument for the great antiquity of man based on the existence of arrowheads and flint flakes, found in certain deposits whose age is indisputable. Contrary to the traditional view regarding the recent advent of man on earth, we have anti-teleologists who claim as the date of the appearance of our race one which carries us back tens, yea, hundreds of thousands of years. And on what do they base their argument? On evidences of mind and purpose. The arrowheads and flint flakes, they declare, and rightly, could not have been fashioned by chance; they could not have been formed by even the highest representatives of the brute creation. They indicate intelligence, design. They must, therefore, have been produced by man. Man, therefore, must have existed long prior to the period usually assigned as the date of his apparition on our planet.

Now, while no one can object to the argument, as thus presented, we find it strangely inconsistent that its validity should be questioned where the evidence of mind and purpose is far more striking —to wit, in the multifarious phenomena of the universe, all of which betoken far more than human intelligence and power. I shall here limit myself to only a single but a most telling illustration—the preparation of the world as the dwelling place of man. The storage of coal as fuel, the introduction of certain plants and animals shortly before the advent of our species, and in strict correlation with it—plants which were almost indispensable as articles of food, and the appearance of animals, such as the sheep, cow, and horse, which

contribute so materially to our comfort and enjoyment—can never, by any sane man, be regarded as the result of mere fortuity, or of the blind and indeterminate action of force on matter. No, the whole grand march of development from the Archæan to the Quaternary period, from the simplest forms of life to the most complex, from monad to man, all speak in the most eloquent and unequivocal language of mind and providence, of a Being who foresees, designs, directs, governs; who in the language of Holy Writ "reacheth from end to end mightily and ordereth all things sweetly"; "Who hath ordained all things in measure, and number and weight."

But teleologists, while maintaining that design and purpose are everywhere manifest in Nature, and while proclaiming that everything is under the government of law, are not guilty of the error into which materialistic scientists so often lapse—that is, of regarding law as a cause, or a power, or as a kind of demiurge independent of the Deity. Far from it. Law in itself is nothing, does nothing, explains nothing. Law is not a force, is not an agent, is not and can not be the efficient or operative cause of anything whatever. Law is only the method according to which force acts; it is but the expression of the mode of divine action. Science has been able to discover a few of the laws of Nature, as it has been able to disclose evidences of design and purpose in the divers realms of creation. And as from the few known laws of Nature men of science are justified in asserting that the entire universe and all it contains are governed by law, so also is the teleologist, from the knowledge he already possesses, equally warranted in declaring that not only the world as a whole, but also everything in it, attests the presence and action of Mind and exhibits such obvious traces of purposiveness that it may truthfully be affirmed that the doctrine of final causes reposes on as firm a basis as does the teaching, universally accepted, that the whole of Nature, animate and inanimate, is under the control of divinely imposed law.

No, it is not true that teleology has been banished from science and theology by recent research, or by the confirmation which is daily being given to the theory of evolution. Teleology has been modified, not destroyed. It has been expanded and ennobled and rendered more subtle and comprehensive than ever before. We now no longer look upon the Creator as directly producing the myriad species of plants and animals which variegate and beautify this earth of ours, but we regard him as operating through secondary agents—creatures of his hand, ministers of his wisdom and power. He is not the immediate cause of the infinitude of forms which characterize the organic and inorganic worlds, but rather the *Causa Causarum*. He is not, as St. Athanasius observes, a car-

penter, but a creator—κτιστης οὐ τεχνίτης. In the beginning he created all things and then impressed on them the power of development, of evolving into the innumerable species we now behold. All things existed in idea before they existed in fact, and the design and purpose which are revealed in animate and inanimate Nature are the witnesses of the foresight and providence of creative wisdom.

Paley and the older school of teleologists pointed to a watch as a beautiful and convincing evidence of design. To the modern teleologist, studying the universe in the light of evolution, it is not simply a watch that presents itself as a witness of purpose running through all things created, from atom to star, but it is a watch which is competent to produce other and better watches. God makes things, it is true, but he makes them by making them make themselves. Similarly, we read purpose in Nature not only by limiting our view to the present and to simple individuals, but also, and more particularly, by studying the species and the class to which individuals belong, in the light of their past history or in the changes they may undergo in the future by reason of varied conditions or continued development. In the words of Mr. Aubrey L. Moore: "If ontogeny, the history of the individual, gives us no answer, we fall back on phylogeny, the history of the race. Organs, which on the old theory of special creations were useless and meaningless, are now seen to have their explanation in the past or in the future, according as they are rudimentary or nascent. There is nothing useless, nothing meaningless in Nature, nothing due to caprice or chance, nothing irrational or without a cause, nothing outside the reign of law. This belief in the universality of the reign of law is the scientific analogue of the Christian's belief in Providence." *

THE principal feature in the orography of South America, from Cape Horn northward, says Mr. Otto Nordenskjold, in describing his journey in southwestern Patagonia, is the contrast between a high Pacific mountain chain and a wide Atlantic table-land. This circumstance causes different parts of the country to wear aspects that are very dissimilar, but nowhere does the contrast appear so strongly as in Tierra del Fuego, where the summits of the Cordilleras, covered with perpetual snow, and very often also by clouds, rains, and fog, can all be seen from the dry Atlantic coast. Not quite so rapid, but still very wonderful, is the transition in Patagonia; and the region lying between 50° and 52° south latitude is in addition more interesting than any part of Tierra del Fuego, owing to the peculiar character given to parts of it by the presence of masses of basaltic rocks and lava cones in the east, and of great ice fields in the western valleys.

* Science and the Faith, p. 197.

DISCOVERY OF NEW CHEMICAL ELEMENTS.

By CLEMENS WINKLER.

IN his studies of the relative frequency of the different elements composing the crust of the earth, Mr. F. W. Clarke supposes that to a depth of ten miles below the level of the sea the composition of the ground is the same as is given by the examination of the surface strata and the depths which we have reached. The mean specific gravity of these strata is 2.5, or not quite half the density of the earth as a whole. Including the oceans and the atmosphere, the exterior crust of the earth is composed half of oxygen and one fourth of silicon, while the other fourth is represented by other elements—aluminum, 7 per cent; iron, 5.10; calcium, 3.50; magnesium, 2.50; sodium, 2.20; and potassium, 2.20 per cent. Some of the elements of which the numerous compounds have long been very obvious to the human ken are, therefore, from the point of view of their quantity, of very little importance; thus, hydrogen stands for only 0.94 per cent of the general composition of the crust of the earth, carbonic acid for 0.21 per cent, phosphorus for 0.09 per cent, and nitrogen for 0.02 per cent. These elements, which are the constituents of immense seas and form the basis of life, therefore furnish only a minute fraction of the mass of the ten-mile-thick ring contemplated by Mr. Clarke. Since the soundings thus far made indicate that they do not exist or hardly exist at greater depths, we have a right to say that so far as regards quantity they may almost be neglected, in considering the mass of the whole globe. The content in chlorine does not exceed 0.15 per cent, yet the common salt alone held in the oceans is sufficient to cover all the continents and bury the highest mountains.

We perceive from this showing how little the impression the outer surface of our globe gives us corresponds with its real nature as we judge of it from its mean density. There can not be the least doubt that the internal parts of the globe are composed of different substances from those which appear in the external strata.

But, while the elements of light specific weight or great volatility which, like hydrogen and nitrogen, exist in large quantities around us, constitute only a very minute part of the constituents of our globe considered as a whole, we presume that the elements called rare only enter in an infinitesimal degree into the general composition of the earth; the more so, because, so far as we as yet know, these elements are not found at great depths. I, at least, do not know that the heavier metals—gold, silver, lead, etc.—have ever been found in the materials extracted from deep soundings or

volcanic ejections. After the mighty eruption of Krakatoa, for example, I sought in vain for these elements in the cinders cast out, which probably came from great depths. The supposed discovery of a new element in the ancient lavas of Vesuvius has been found to be erroneous.

Elementary bodies seem to multiply as we approach the surface of the globe. Two hypotheses suggest themselves in explanation of the fact: that of displacements of cosmical matter, and that of the new formation of elements on the surface.

The displacements of cosmic materials are incessant; falls of meteorites furnish a particularly striking example of them, but it is probable that as to quantity the cosmical dusts are of more importance. Yet neither the meteorites found at various points nor the dust collected by Nordenskiold in the ice fields of the polar regions, the extra-terrestrial origin of which can not be doubted, contain the rare elements of the earth. The hypothesis of an increase by accretions from without appears to lack foundation.

The new formation of elementary bodies seems to be still less probable; at most it might be explained by the possibility, often indicated but never established, of a new reduction of bodies heretofore supposed to be simple. Spectrum analysis, it is true, reveals to us transformations which are gradually going on in the matter of the fixed stars, but they are only of known substances becoming converted into other substances equally known. Moreover, the conditions of temperature and aggregation of the fixed stars and those of the earth can not be compared.

It is evident that the increase of simple bodies in the outer strata of the earth is only apparent. It should be recognized, besides, that science has made great progress, and this progress can not be without influence on the discovery of new substances. The first electrolytic decompositions accomplished by Davy with an inferior voltaic pile made known at the beginning of this century the existence of metallic radicles in the salts and the earth of which there had not been before the slightest suspicion; while Moissan, by the employment of the powerful currents now available, has been able to disengage fluorine—hitherto almost unknown—from its combinations. Spectrum analysis has cast light on a whole series of elements of characteristic spectra. The presence of one of these elements, helium, had been demonstrated in the sun before it was known that it likewise entered into the composition of our globe. The conclusions drawn by D. Mendeleef from the periodical law have also led to the discovery of several elements the existence of which was indicated by theory before the chemist had isolated them. I mention, first, scandium, discovered in 1879 by Nilson in exonite,

gadolinite, and yttrotitanite. This metal, the oxide of which exists only in quantities of a few grammes, and which no person, perhaps, other than the author of the discovery has had in his hands, possesses considerable scientific importance, because its atomic weight of 44, as determined by Nilson, is precisely that indicated by Mendeleef for *ekabor*, an element the existence of which was predicated by the periodic law.

In 1794, Gadolin had separated from the gadolinite of Ytterby an earth which he called the earth of Ytter, and which was afterward known under the forms of erbia, terbia, and yttria proper. These earths were found in a considerable number of rare minerals, but the oxides extracted from these minerals exhibited different natures and aspects, presenting themselves rather like mixtures in which the separation of the different constituents was attended by considerable difficulties, for the different elements gave no very distinct reaction. It was necessary to recur to spectrum analysis and to the determination of atomic weights, and to try to isolate them by repeated fractionings, under the action of sulphate of potassium or of ammonia, or else by the partial decomposition of the nitrates by heat. The bulk of these analyses, the results of which are not, however, entirely clear as yet on some points, have been performed within the last quarter of a century, and, besides securing more precise knowledge of scandium and yttrium, have revealed the existence of numerous other rare elements, the reduction of which does not seem impossible; among which we cite erbium, holmium, thulium, dysprosium, terbium, gadolinium, samarium, decipium, and ytterbium.

Cerium, lanthanum, and didymium have been the object recently of very attentive researches having a practical end in view—the constitution of mantles for incandescent gaslights. Didymium has been long suspected of not being a simple substance; but Carl Auer von Welsbach, the inventor of this method of illumination, is entitled to the credit of having succeeded, in 1855, in separating didymium into its two elements of præsodidymium and neodidymium. The utilization of monazite afterward permitted the preparation of the salts of these remarkable metals in larger quantities, and the practical use of them.

The existence of metacerium, announced by M. Brauner, does not yet appear to be fully established, nor that of russium, which M. Crushchow has found associated with thorium in some zircons and in monazite, and the atomic weight of which is calculated at 220. The jargonium of Sorby, the austrium of Linneman, the norvegium of Dahll, the actinium of Phipson, the idumium of Websky, the masrium of Richmond and Off, and

an unknown element which M. K. J. Bayer thought he had found in French bauxite, have returned to nothingness. We mention also merely as a matter of curiosity a kosmium and a neokosmium, deriving their names not from Cosmos, but from Kosmann, who took out a patent for the preparation of their oxides.

Gallium was discovered in August, 1875, by Lecoq de Boisbaudran in the blende of Pierrefitte, through two very distinct lines in the violet of the spectrum of that mineral, which, however, as afterward appeared, contained only a slight proportion of the new metal —not exceeding 0.0001 per cent—while in the richer blende of Bernbryer it amounted to 0.001 per cent. The preparation of gallium in any considerable quantities was attended with great difficulties on account of the want of a proper mineral to be practicably submitted to the extraction process, and none has as yet been found. Still, the study of the new metal was very interesting, in view of the theoretical speculations of Mendeleef. Scandium and germanium had not yet been discovered, and there was therefore nothing to justify or confirm the conclusions drawn from the law of periodicity. As early as 1869, Mendeleef had affirmed the existence of simple bodies still unknown, the atomic weights of which should be comprehended between 65 and 75; he had even gone so far as to describe in detail the properties of the three hypothetical elements—*eka-boron*, *eka-aluminum*, and *ekasilicon*. We can imagine the interest attached to the question whether the properties of gallium corresponded with the anticipations of the Russian chemist.

At first, the correspondence did not seem to exist; the determinations made on the small quantities of gallium that could be obtained gave the specific gravity the unexpected value of 4.7. But as many of the properties of the new metal—such as the precipitation of its solutions by carbonate of barium, its tendency to form basic salts, and its capacity of forming alums—denoted a relationship with aluminum, Mendeleef had no hesitation in declaring that the new element appeared to correspond with the one the existence of which he had indicated in 1874 as similar to aluminum, and which he had called eka-aluminum. A new determination, made with considerable quantities of gallium obtained by electrolysis, brought the value of the specific gravity up to 59, which correspond exactly with the value calculated by Mendeleef for the hypothetical eka-aluminum. The specific heat (0.08) was afterward found to correspond with Mendeleef's estimate, and the justness of his previsions was established. It was therefore shown to be reasonable to deduce from the properties of known elements those of others still unknown, but the existence of which is anticipated. Mendeleef had not expected so quick a confirmation of his

previsions; but his triumph was destined to be still more complete, for to gallium were afterward added *scandium* (ekaboron), discovered by M. L. F. Nilson in 1875, and *germanium* (ekasilicon), discovered by me in 1886.

The discovery of germanium, predicted under the name of ekasilicon by Mendeleef, bears a resemblance to the discovery of the planet Neptune, the existence of which had been shown by the calculations of Adams and Leverrier. That discovery was not due to a concurrence of favorable circumstances or to a happy accident, but was the result of researches inspired by theoretic previsions, and the concordance between the predicted and the real properties was so great that Mendeleef regarded the discovery of germanium as an important verification of the periodic law. On only one point—that touching its formations in Nature—did germanium completely fail expectations. The search for it would be more likely made as an oxide in the rare minerals of the north, along with titanium and zirconium, than as a sulphide accompanying similar compounds of arsenic and antimony in gangues of silver-bearing minerals. This fact, with the comparative rarity of its mineral, argyrodite, has contributed no little to delaying the elucidation of its real character. For myself, I was at first inclined to regard it as eka-antimony, while Mendeleef, after my first incomplete communications, thought it was ekacadmium. At the same time, M. von Richter expressed the conviction that germanium was nothing else than the long-expected ekasilicon, a conclusion that was justified by the correspondence of atomic weights.

The success of the bold speculations of Mendeleef permits the affirmation that the elaboration of the periodic system constitutes a great forward step for science. In the course of only fifteen years all the predictions of the Russian chemist have been confirmed. New elements have come to fill the vacant spaces in his table, and there is every reason to hope that a like fulfillment awaits the rest of the natural system.

Yet the two elements last discovered, *argon* and *helium*, do not seem to present any relation with the periodic system. The physical properties of argon are very distinct; its characteristic spectrum distinguishes it with great certainty from all other substances; but chemically the gas manifests an extraordinary indifference, and it has not so far been possible to make it enter into the usual compounds with other elements. This peculiarity, and the impossibility of introducing a simple body of the molecular weight of argon (39.88) into the periodic system, have given occasion to all sorts of hypotheses concerning the gas; and the question of its relations has not yet been answered.

Another most interesting discovery is that of helium, which was made by Professor Ramsay, in 1895, while examining the mineral cleveite for argon, when, besides the spectrum of argon, he observed another bright line not belonging to that spectrum, which Mr. Crookes recognized as identical with the line D^3 which Professor Lockyer had observed in 1868 in the spectrum of the solar chromosphere, and which he attributed to an element not yet known on the earth—helium. The same line was afterward found in the spectra of other fixed stars, and the conclusion was drawn that helium exists in large quantities outside of the earth. On our planet it seems, however, to be very rare, and may even be ranked among the rarest elements. Yet it has been almost discovered several times. Palmieri observed the line of helium in his researches on the lava of Vesuvius, but did not push the matter further; and Hillebrand in 1891 obtained in the spectrum of the gas formed by uranite lines which were presumptively those of helium. Since its discovery, helium has been found in a considerable number of minerals, generally associated with uranium, yttrium, and thorium; in mineral waters and, in extremely small quantities, in atmospheric air. Next to hydrogen, it is the lightest of the gases, and from this peculiarity Stoney draws an explanation of the fact that these two elements exist only in very small quantities in a free state on the earth, while they are diffused in enormous masses through the universe. The relatively small force of the earth's gravitation does not furnish an adequate counterpoise to the velocity of their molecules, and they escape from the atmosphere of the earth, unless they are restrained by chemical combination. They then collect around the great centers of attraction constituted by the stars, in the atmosphere of which they exist in large quantities.

The study of the spectrum of helium is extremely important, because it gives interesting data concerning the nature of distant celestial bodies. It also, as the labors of Runge and Paschen have shown, suggests doubts concerning the elementary character of the new substance. Whatever it may be, if we have to suppose that helium is composed of two gases (Mr. Lockyer has proposed the name of *asterium* for the second), one of the two gases probably has a boiling point very near the absolute zero, and in any case below $-264°$ C.; for the master in liquefaction of gases, M. K. Olszewsky, has not up to this time succeeded in provoking a change of state of helium, and he proposes to use this gas for filling gas thermometers for measuring extremely low temperatures. Helium has shown itself thus far as refractory as argon to all chemical combination, and so great an uncertainty reigns over the position to be attributed

to it that I pass by the hypotheses that have been set forth with respect to the matter.

It is not impossible that the discovery of these two new elements, argon and helium, may give occasion for a remodeling or a transformation of the periodical system—a remodeling by means of which some uncertainties and even contradictions now existing will undoubtedly be removed. Thus, for example, the atomic weight of tellurium, as recently determined by B. Brauner and Ludwig Standenmaler, does not enter at all into the periodical system; on the other hand, the existence in this substance of a foreign element, such as the *austriacum* suggested by B. Brauner, does not seem to be established. As to the much-agitated question whether and to what extent the atomic weight of nickel differs from that of cobalt, I believe I have given a satisfactory answer, and have refuted the hypothesis of Gerhard Krüss and F. W. Schmid of the existence in one of the substances of a third element which has been called *gnomium*.

The rapid glance which we have cast over the discovery of new elements during the last twenty-five years shows that researches have been pursued in this direction with great activity, and with the return of considerable results. Yet the speculations for which these researches have given occasion with respect to the possibility of an ultimate decomposition of apparently simple bodies, and reciprocally respecting the progressive development of the primitive substance and the formation of many of the present elements, may be considered very uncertain. I mention among these Mr. Lockyer's hypothesis of the dissociation of the elements within the solar atmosphere. Hypotheses of this kind must remain hypotheses so long as we do not succeed in splitting a substance unequivocally regarded as simple, or in transforming some element into another; yet they need not be considered wholly inadmissible. Something unexpected may happen at any time that will open to science new roads of investigation.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

FROM the results of an investigation as to the use of fermented drinks by prehistoric peoples, M. G. de Mortillet concludes that the lake dwellings of Clairvaux in the Jura and of Switzerland show that the neolithic people of central Europe had a wine made from raspberries and mulberries; and the dwellings of Bourget in Savoy and various stations in the Alps, that the use of this wine continued through the bronze age. On the southern slope of the Alps the relics of the dwellings between the prehistoric and the protohistoric ages reveal the use of another fermented liquor, prepared from the dogwood. Traces of the use of wine from grapes are found in the terramares of the plain of the Po, going as far back as the earliest bronze age.

THE SIGNIFICANCE OF LANGUAGE.

By MICHEL BRÉAL.

NONE of the works on linguistics which come out one after another, whether for the use of students or of the general public, seem to me to offer exactly what they ought. To one who knows how to question it, language is full of lessons, because man has laid up in it for many centuries the acquisitions of his material and moral life. If only the changes of vowels and consonants are considered, the study is reduced to the proportions of a secondary branch of acoustics and physiology; if the study is directed to the counting of the losses suffered by the grammatical mechanism, it gives the illusion of a building falling to ruin; and if one confines himself to vague theories on the origin of language, he adds a chapter of not much value to the history of systems. It seems to me that there is something else to be done. The extraction from linguistics of what can be drawn from it as food for reflection and as a rule for our own language (since each of us is doing his part in the evolution of human speech) is the thing that should be made most prominent, and that I shall attempt.

My present effort is to study the mental causes which have influenced the transformations of languages. In order to give system to the investigation, I have arrayed the facts under a series of laws—to which term we must not attach an imperative significance, for none of these laws is without exceptions; and I take pains to define for each law the limits within which it is operative. I aim to show that the history of language, besides achieved changes, furnishes numerous cases of attempts that have been carried only part way.

To introduce the will as a factor in the history of language after so much pains have been taken within the past fifty years to exclude it, seems almost like heresy. But while it was proper to discard the puerilities of the science of the past, we have been content to take up with the opposite extreme of a too simple psychology. We shall have to shut our eyes to the evidence to fail to see that an obscure but persevering will presides over changes of language.

How shall this will be represented? I believe it should be represented under the form of thousands and millions and milliards of tentative essays, usually unsuccessful, but sometimes followed by a quarter or a half success, which, thus guided, corrected, and improved upon, at length take some precise direction. The object, in language, is to be understood. The child exercises itself for months in speaking the vowels and articulating the consonants; and how many failures does it make before it clearly pronounces a

syllable! Grammatical innovations are of the same kind, with the difference that a whole people collaborates in them. How many awkward, incorrect, and obscure constructions, before finding the one which will be, not an adequate—for there is none such—but a passably sufficient expression of the thought! There is nothing in this long labor that is not of the will. In pursuing this study, we have no need to look for facts of a complicated nature. As in everything where the popular mind is in play, we find a surprising simplicity in the means, in striking contrast with the extent and importance of the effects. I have designedly taken my examples from the best known languages.

We give the name of *repartition* to the intentional process by which words that were synonymous take on different meanings, and can no longer be used for one another. Most linguists deny that there are repartitions, and, when confronted with examples, assert that they are made by scholars and are not popular. The public, however, are not of this opinion. They admit the existence of repartition, and do not believe that there are two absolutely identical terms. Now, since the public is the depository and the author of language, its verdict that there shall be no synonymy is effective to work the disappearance of any synonym in a short time. A class of distinctions between words is discredited by their having been made in the study by pretentious teachers of language who have not been called to the task. There are no real distinctions other than those which are made without premeditation, under the pressure of circumstances by sudden inspiration, under the impulse of a real need, by persons who are dealing with the things themselves, associating the words with them the moment they see them.

When two languages or two dialects exist together, a work of classification takes place, and synonymous words are given different ranks. Words rise and fall in dignity as an idiom is considered superior or inferior. Linguistics is here a social or a national affair. As M. J. Gillieron relates of the Lower Valais, where French has encroached upon the Swiss dialect, that the latter has been debased and become vulgar and trivial. Since the French word *chambre* has come in for the bedroom, the old word *pailé* has been applied only to the garret. In Brittany, according to the Abbé Rousselot, gardens were formerly called *courtils*, but now that the word *jardin* has been introduced, a kind of slight has been attached to the old rustic word. It makes no difference if both terms are of the same origin. The Savoyard calls his own parents *père* and *mère*, French, while the fathers and mothers of his cattle are his native *pâré* and *mâré*. What the people do by instinct, all constructive science, all deep analysis, all discussion that has an object, every reflective opinion that would

define itself, does with the same spontaneity. Two words, formerly synonymous, are differentiated by an immediate apperception. The history of language is a series of repartitions. The earliest stammering of a child is nothing else, for it is by repartition that he applies to distinct objects the sylables which he at first bestowed indifferently on everything he met.

When the popular mind has once determined a repartition of a certain order, it is naturally tempted to complete the series. There are languages in which the different acts of life are not designated in the same way when performed by a person of high dignity and by a common person. To express that a man eats, the Cambodians use the word *si;* in speaking of a chief, *pisa;* and of a bonze or king, *soï.* In speaking to an inferior, I is *anh;* to a superior, *knhom;* to a bonze, *chhan.* The followers of Zoroaster, who regard the world as divided between two opposing powers, have a double vocabulary, according as they speak of creatures of Ormuzd or of Ahriman.

Nothing, in fact, is more natural or more necessary than repartition; for our mind collects words from different ages and different mediums, and would be in absolute confusion if it did not give some kind of order to them. We all do what the dictionaries of synonyms do; when we examine the terms which usage distinguishes or subordinates, we find that etymology rarely gives a reason for the differences we assign to them. If we take, for example, the words genus and species, what reason is there for giving one a larger capacity than the other? There is nothing in the words *division, brigade, regiment,* and *battalion* to indicate the special and exact subordination of one to another that exists between them. Passing to moral ideas, we perceive no gradation imposed by etymology in the words *esteem, respect,* and *veneration.* It required precise and clear minds, a society well ordered and careful of its ranks, to establish some of these distinctions.

Still, repartition has its limits. First, as it does not create, but attaches itself to what is to be distinguished, terms to be differentiated must exist in the language. We might cite instances of confusion from which, for the lack of a word, the most perfect idioms have never succeeded in freeing themselves. On the other hand, the mind may not always be able to fructify all the riches the language offers it. Grammatical mechanism, by combining existing elements, could produce such a quantity of forms that the mind would be embarrassed with them. George Curtius calculated that the number of personal forms in the Greek verb rose to 268, but this is much inferior to the 861 forms of Sanskrit. Another limit is imposed. Certain shades of meaning are possible only among cultivated peoples. In synonymy we can discern what objects the thought of a nation is occu-

pied with. Distinctions are made first by the finer minds; then they become common to all. Intelligence consists largely in perceiving the difference between similar things. It is imparted, in a certain degree, by language, for, in order to recognize differences which the best endowed were at first the only ones to feel, the view of each one becomes keener.

From what has gone before, we draw the conclusion that language designates things incompletely and inexactly. Substantives are labels attached to things, and include just that part of the truth which a name can contain. The names most adequate to their objects in our languages are abstract nouns, because they represent a simple operation of the mind. When I pronounce the word *compressibility* or *immortality*, all that is in the idea is contained in the word; but if I take a real being, an object existing in Nature, it will be impossible for language to put into the word all the notions which that being or that object awakens in the mind. Language is forced to select. Among all the notions it chooses one, and thus creates a name which at once becomes a sign.

There is no reason to fear that the importance of language in education will ever be depreciated. We can trust that to the mothers. Their first impulse is to speak to the child, their highest joy to hear it speak. Then come masters of all degrees and sorts, each of whose art supposes language. In every country, ancient and modern, language has supplied the instrument and the prime material of instruction. This universal agreement is natural. We shall have no difficulty in understanding the nature of the action of language on the mind if we reflect that we do not, any of us, receive it in block all at once, but are each obliged to reconstitute it anew. An apprenticeship takes place which, although it escapes notice and is not recognized even by the one who passes through it, is nevertheless a sort of training school of mankind. Since the best teachers are those who give us the most to do ourselves, what more profitable study can we conceive for the child? What attention is required simply to distinguish the word! We have to disengage it from what precedes and from what follows it; to discriminate between the permanent and the variable elements, and to understand that the permanent element is committed to us to handle in our turn and subject to the same variations. The simplest phrase is an invitation to decompose the thought and see what each word contributes to it. The adjective and the verb are the first abstractions comprehended by the child. Imagine the effort which the ancient languages required even to speak them passably! There was a whole chapter of inner life in it which began again in each person. The people carried within themselves an unwritten grammar, which indeed

slipped into errors and faults, but which nevertheless had a degree of fixedness, for these languages were transmitted from generation to generation for ages. When we consider how much trouble it takes now to learn these languages, we are surprised. But we must recollect that education in the maternal language has the advantage that it is going on all the time and everywhere, that it is stimulated by necessity, that it addresses itself to fresh minds, and that it offers the unique characteristic of associating words with things, and not the words of one language with those of another. The same conditions are in play in all mother tongues, and in all the child's mind achieves a triumph. Our modern languages, while less encumbered with formal apparatus, are still not far from it; and the complication bears upon another point, consisting in the use of words of slight meaning, and so abstract and servile that we never think of them, while we always put them in their proper places. In this we observe intelligence passing to a condition of instinct. This is not through any kind of a notion of the value of the word, but by virtue of a certain number of locutions which memory retains, and which serve as models. Our intelligence derives the same services in daily operations from language that we derive from calculations. In consequence of the infirmity of our understanding, it is easier for us to deal with the signs of ideas than with the ideas themselves. Before the invention of writing, men counted with pebbles. Doubtless this idea must come first; but it is vacillating, fugitive, hard to transmit. Once incorporated into a sign, we are sure we have it, and can direct it at will and communicate it to others. This is the service performed by language; it renders thought objective.

If I had to say in what the superiority of the Indo-European languages consists, I should not seek for it in the grammatical mechanism, or in the compounds, or in the syntax; but in the facility with which those languages, from the most ancient times of which we know, have created abstract nouns. If we observe the suffixes which serve this purpose, we shall be surprised at their number and variety. It is the presence of these nouns in large number, as well as the possibility of making others after the same type, that adapts the Indo-European languages so well to the expression of all the operations of thought.

Accustomed as we are to language, we do not easily conceive of the accumulation of mental labor which it represents; but, to satisfy ourselves concerning it, we have only to take up some book and eliminate all the words which, not corresponding to any objective reality, summarize a mental operation. Hardly anything would be left of the page thus pruned. The peasant who talks of time and seasons, the tradesman who expatiates on his stock of goods, and

the child who brings his certificate of conduct or advancement, move in a world of abstractions. The words *number, form, distance, situation,* are so many mental concepts. Language is a translation of reality, a transposition in which objects figure already generalized and classified by the labor of thought.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

SKETCH OF CARL SEMPER.

CARL SEMPER is characterized by Dr. August Schuberg * as a student who, while being especially thorough in a particular line of research and generally preferring it, was remarkably free from that kind of specialism which is so common and often detrimental to science as a whole. "There are few investigators who have made themselves so familiar with the most various groups of the animal kingdom through their own researches as he; and he most catholicly busied himself with all branches of zoölogy—anatomy, histology, embryology, physiology and general biology, systematic biology, and geographical distribution—in all of which he pursued his own lines of investigation, so that it may be said that there are few regions of zoölogy which he did not explore." He was also an industrious student in anthropology and ethnology.

CARL GOTTFRIED SEMPER was born at Altona, July 6, 1832, the son of the manufacturer Johann Carl Semper, and died at Würzburg, May 29, 1893. He attended the gymnasium of his native city till he reached the Secunda, and then entered the school for naval cadets which was founded by the "Provisional Government" of Schleswig-Holstein at Kiel in 1848. Not finding the conditions here very attractive, he joined the artillery as a volunteer and engaged in a brief campaign against the Danes. When Schleswig-Holstein was given up to Denmark, he, by his father's advice, attended the Hanover Polytechnic School from 1851 to 1854. At the University of Würzburg (1854 to 1858) he gave special attention to comparative morphology and histology. Having received the degree of Doctor of Philosophy at Würzburg in 1856, he continued his studies there and at the Kiel High School in 1857, and in November of that year started on a tour through Germany, France, and Spain, the object of which, he said, was partly study in the museums and libraries, and partly to find associates who would join him in a more extensive scientific journey. His inten-

* In Arbeiten aus dem Zoologisch-zootomischen Institut in Würzburg, in an article whence the material for this sketch is derived.

tion, in which he was encouraged and assisted by his liberal-minded father, was to visit the Philippine Islands, alone if he should not find suitable companions. In the hope that he might thereby further advance his scientific purposes, as well as in order to gratify his taste for a sea life, he determined to make the voyage on a sailing vessel. Reaching Manila in December 1858, he devoted the first half year of his stay there to making himself acquainted with the country and the people and to mastering the language, and, limiting his zoölogical rambles at first to the neighborhood of the town, did not undertake any more extensive excursion till August, 1859, when he went to the southern part of the Philippines. During a residence of seven months at Zamboanga and on Basilan, in addition to his zoological and other scientific researches, he studied the anthropology and ethnology of the Mohammedan Malays living there. Returning to Manila in March, 1860, he began the next month a second long journey to the northeastern part of the island of Luzon, where, besides zoölogical studies, he had an opportunity to become acquainted with the heathen tribes of Malays and collect much new and valuable anthropological and ethnographical material.

His activity was interrupted for several weeks by illness, and, following the advice of a physician, he embarked for the Pelew Islands, where he intended to study the coral formations. His vessel was leaky and unseaworthy, and the voyage was lengthened by the necessity of running in often at the different islands for repairs. His stay at the Pelew group was prolonged for months by delay in putting the vessel in proper condition for the return voyage, and he suffered great hardships, but formed very pleasant relations with the natives; and this, with the richness of the scientific and ethnological treasures he acquired, was ample compensation for all.

Having returned to Manila, he was married to Anna Hermann, of Hamburg, and they soon afterward went to the island of Bohol, north of Mindanao, whence he in the same year (1862) made brief excursions to the neighboring islands of Cebú, Leyte, and Mindanao. The last of the series of expeditions from the Philippine Islands was made to the interior of Mindanao from May till December, 1864; and in May, 1865, Semper left Manila for home.

Near the close of this year Semper was licensed by the Philosophical Faculty of Würzburg as *Privat Docent* in zoölogy. In February, 1869, he was appointed professor extraordinary. Ten days later he became a temporary supply for Professor Leiblein, who was ill, and on Leiblein's death, in August of the same year, he was appointed regular professor and director of the zoölogical cabinet. In 1870 he was invited to go to Göttingen, but decided to remain at Würzburg.

This preference was recognized by the authorities of the university in an assurance that a reorganization of the zoölogical cabinet—the arrangement of which was poorly adapted for purposes of instruction—should be begun, to be completed in five years. Professor Semper proceeded at once with a provisional rearrangement, and with the foundation of a museum of comparative anatomy; and the former zoölogical cabinet was named by the Academical Senate in December, 1871, the Zoölogical Zoötomical Institute. The number of his pupils increased, and many valuable studies were undertaken by them under his lead and at his suggestion; but all their work was hampered by want of means and of space. A site for a building had been granted the university by the city authorities of Würzburg in 1875, but no building money had been appropriated, and the question of the way in which funds could be obtained offered a serious problem.

His work at Würzburg suffered several interruptions. During the war of 1870 his characteristic energy found full sway in the direction of the transportation of provisions and hospital furnishings to the seat of hostilities, in which he was several times engaged. A sojourn in Heligoland in 1873 and 1874, and a visit of a few months in 1876 in company with some of his pupils to the Balearic Islands, were of much advantage to his scientific work. Most important results of his residence in Heligoland were his thorough investigations of the excretory organs of the shark.

In 1877 Professor Semper was invited to deliver the Lowell Institute Lectures in Boston, and improved the opportunity to travel over the western part of our continent. The substance of the twelve Lowell Lectures was afterward embodied in the book, Animal Life as affected by the Natural Conditions of Existence, which was published as No. 30 of the International Scientific Series, and is characterized by Dr. Schuberg as one of his most important works.

In 1887 Professor Semper suffered a stroke of apoplexy, by which his life was immediately endangered and his vigor was permanently weakened. For a short time he seemed to recover very rapidly, but the evidence of advancing disease which was destined to end in his death became gradually plainer. Still, he would not spare himself, but labored on, as he had done in his younger days, to his injury.

One joy, however, was still to be afforded him. The Bavarian Landtag in 1887 voted money for the erection of a zoölogical institute. He was permitted to have this building constructed according to his own views. It was ready for use in November, 1889, and he was able to enjoy it for a short time; but his health continuing to fail, he was not permitted to carry on the investigations for which it had

been constructed, and was compelled to ask to be relieved of the work of teaching at the end of the year 1892. His successor as director of the institute was appointed at the beginning of the summer semester of 1893, and his own death followed shortly afterward.

The versatility by which Professor Semper was distinguished, and of which we have spoken at the beginning of this sketch, was rarely favored, in Professor Schuberg's view, by his long sojourn in the tropics; for when one is so situated, as he was then, as to be able to spend seven years and a half in the study of the exceedingly diversified and interesting animal forms of luxuriant tropical nature, without being concerned about outside conditions and without having any other duties, he enjoys facilities and is assisted to an extent which few zoölogists can hope for; and he used these opportunities in a manner which attests his extraordinary energy and his capacity to give equal and impartial attention to every branch of his science. His earlier works, before going to the Philippine Islands, and his first researches there were in comparative morphology and histology. As his investigations continued, they were extended to numerous and diversified animal groups, and gave rise to many important discoveries. Of special interest among his publications concerning these researches were his papers on the origin of coral reefs, on the *Trochosphæra*, and on the alternating generations of stone corals. Of special permanent value likewise are his monographs on holothuria and land mollusks. He busied himself, too, with questions of geographical distribution and general biology; and he is credited by Professor Schuberg with having contributed much to the building up of Darwin and Wallace's doctrine of descent, by his efforts to bring some of the questions nearer solution, and by his objective criticisms. Two works are especially mentioned which advanced the discussion of the questions raised by the theory of descent. One of these embodies a series of connected investigations, the results of which go to close a gap which had to be bridged if the theory of descent were to be set upon a stable foundation. Professor Semper, almost simultaneously with the Englishman Balfour, had made the important discovery of the presence of structures in sharks, both embryos and full grown, which attested a conformity of the structure of the urogenital system of vertebrates with that of the annelids; and he believed that he had at last found the bridge which was to be laid from the vertebrate to the invertebrate type. Thus arose, in the building up of the theory based upon this first observation, a series of researches, in which he tried to demonstrate a conformity in structure of the vertebrates and the articulate worms for other organs than the urogenital apparatus, and materially promoted the

solution of extremely important problems of animal morphology, particularly those of segmentation, budding, and strobilation.

Professor Semper did not succeed in obtaining general acceptation of his views on the derivation of vertebrates, but the observations and arguments on the special point, and on general questions, too, set forth in the works relating to them, exercised a remarkably stimulating influence on the further discussion of the problems involved.

The second work in which Professor Semper considered the zoological problems raised by Darwin's theory is the book on Animal Life as affected by the Natural Conditions of Existence. The fundamental thought of this book, as defined by the author in his preface, was that, as Jaeger had said, enough had been done in the way of philosophizing by Darwinists, and the task now presented was to apply the test of exact investigation to the hypotheses that had been laid down. Without pretending to have made a complete presentation, his end would be attained if he should have given an impulse to research, on however small a scale, so long as it should be systematically conducted and thoroughly carried out—"if only it should contribute to extend my own conviction as to the uselessness of casual and disconnected observations." The book is described by Dr. Schuberg as a remarkably stimulating one, and no compilation; for, besides permeating and enriching the subject with numerous new thoughts, he incorporated in it a very large number of his own observations, made for the most part during his voyages. Professor Semper further contributed to the literature of zoölogy numerous smaller and special papers, a considerable proportion of which, his own, or composed with the co-operation of his pupils, were published in the *Arbeiten aus dem Zoologisch Institut in Würzburg*. The whole list of his writings, as given by Dr. Schuberg in the biography published in that journal, comprises ninety titles.

Professor Semper contributed also to other fields of literature. His journeys in the Philippine Islands took him into regions rarely visited by Europeans, and of the anthropology and ethnology of which little was known. He included these features within the range of his studies, and was able to cast considerable light upon them. Besides single essays, two works are especially worthy of notice as fruits of his industry in these lines of research—The Philippine Islands and their Inhabitants, which treats of the geographical and ethnological aspects of the group; and The Pelew Islands of the Pacific Ocean, presenting a corresponding view of that still less known region. In 1869 he became one of the editors of the *Archiv für Anthropologie*. Considerable literary value also attaches to his academical lectures.

Professor Semper had a rare art of attaching his students to himself. His manner of meeting and greeting them attracted them. His intercourse with them was friendly and cordial, and was not confined to the hours of instruction. The students of the Würzburg Institute, Dr. Schuberg says, when Professor Semper was in the height of his power as a teacher, constituted a family, of which he was the head. He knew how to pick out the students inclined to independent thought, to draw out their peculiar traits, and to prompt each of them to develop his individuality, or cultivate his habit of independence. Hence, although he had many students, he formed no "school."

A WRITER in the London Spectator, visiting the Zoölogical Gardens in Amsterdam, was much interested in the colony of nesting cormorants on one of the small canals crossing parts of the grounds, where the "domestic side of cormorant life could be seen at close quarters." The birds carried on there their daily work of "fishing, nest-building, sitting on eggs, rearing the young, quarreling for 'stands' for future nests, or basking in the sun within a couple of yards of the path. At the time of the writer's visit there were five nests built close to the water. They were made of large sticks piled to a height of from two feet to three feet. One held a pair of young cormorants, covered with close, black down. In the second were three birds of rather larger growth. On a third nest an old hen bird was still sitting on her eggs, while the cock kept guard on the ground in front. The compact and glossy plumage of both shone with gleams of black and purple luster, set off by the pale yellow skin on the cheek and bill. The cormorant is not usually credited with beauty, but, like the starling, it is a lovely bird in the breeding season, when the sight of the old cock rushing to battle with all intruders, exchanging rapierlike thrusts of the beak with his enemies, croaking, swelling his throat, and even throwing himself on the ground to prevent access to the nest, makes a pretty illustration of bird courage. All this fuss and excitement is confined entirely to the male birds. The hens are quite ready to see a little company when sitting; and two were seen sitting side by side on eggs laid in a joint nest."

CARL VOGT'S publication of his theory of microcephalism caused great offense in certain circles in Germany, and even the children in the streets would sometimes call after him "*Affenvogt*." William Vogt relates in his *Vie d'un Homme* that, desiring to examine a specimen of microcephaly in a strictly closed convent at Eger, Carl took advantage of the doors being opened for General de Gablenz, and attached himself to his party. They were all received cordially and given the freedom of the house. The friar pastor exhibited as the greatest curiosity of the convent "a real man-monkey," a microcephal, which Vogt examined at great length. While he was measuring its angles, the monk exclaimed: "A real man-monkey, isn't it? Wouldn't that pestilent monster of a Carl Vogt be happy if he could see it! I am not malicious, but if he should come within a league of this place he would be lost!"

Editor's Table.

EVOLUTION AND DESIGN.

UPON another page of the present number will be found an interesting article by an eminent Catholic theologian, the Rev. J. A. Zahm, C. S. C., under the title of Evolution and Teleology. The point of view which the writer takes up is not one that we can share; but he states his case with candor and ability, and we hold that views so stated are entitled to expression in a periodical which stands, and has always stood, for the freest discussion of all scientific and philosophical questions.

It will be observed that Father Zahm is prepared to make, and very frankly makes, large concessions to modern science. He considers that the doctrine of evolution in its general aspect may be considered as proved. As to what Huxley has called the Miltonic doctrine of creation, he says that "all the conclusions of contemporary science render it not only in the highest degree improbable, but also exhibit it as completely discredited, and as unworthy of the slightest consideration as a working hypothesis to guide the investigator in the study of Nature and Nature's laws." He admits further that, in the light of the Darwinian theory, the reasonings which satisfied our fathers on the subject of design in Nature have become to a large extent obsolete. The authors of the Bridgewater Treatises, excellent observers of Nature as they were, regarded the adaptation of a given organism to its environment as the result of direct purposive action on the part of the Creator, entirely analogous to the action whereby a locksmith fits a key to a lock. From the modern point of view adaptation is simply the necessary condition of existence. Given a geometrical rate of increase in vegetable and animal forms, and the sifting or selective action of the environment will do the rest.

Father Zahm accepts the modern point of view, but does not on that account abandon the idea of design. He quotes certain modern writers, among whom he erroneously includes Huxley, as saying that the teachings of Darwin have simply rendered necessary a restatement of the former argument. Instead of regarding each form of life as miraculously adapted to its environment in the act of creation, we are to consider that the evolutionary process was designed to develop just such forms of life as we now see. A certain Professor Schiller is quoted as maintaining that "once we adopt the evolutionist standpoint, the argument from design is materially and perceptibly strengthened," and that in two ways: positively, by letting us behind the scenes and showing us how effects are produced; and negatively, by removing the necessity for proclaiming everything perfect, seeing that some things, if not all, may properly be considered as only in course of being made perfect. Inasmuch as the view of creation which Huxley, to avoid offense, called Miltonic is really the view which accepts in a plain sense the plain teachings of the book of Genesis, and as that view involves the perfection of all things as they came from the hands of the Creator, who pronounced them "very good," it is evident that Father Zahm adopts a standpoint far in advance of the literalism of popular theology. He recognizes that these matters be-

long to the domain of science, and that scientific investigation can not be arrested by any dictum uttered in the name of purely theological studies or merely traditional opinions.

The main question, however, which his article summons us to consider is whether the doctrine of evolution, which he accepts, lends itself to a teleological interpretation; and upon this point we must say that he, and the authors whom he cites, seem to place their argument on a very unsubstantial foundation. How does the matter stand? There is no question that Nature abounds in examples of what, for want of a more suitable term, we may call adaptation. The eye is "adapted" for seeing, the hand for grasping, the stomach for digesting, and so on. The older naturalists and philosophers, not being able to conceive of any other method by which adaptations could be brought about than that of purposive action, by some power capable of molding the forms of life as the human mechanic shapes the materials in which he works, argued, naturally and reasonably from their point of view, that a special divine power had designedly fashioned each form and each organ so as to fit them for the precise place they were to fill and the work they were to perform in the general economy of things. Paley's argument from a watch was considered irresistible in its day. If, he said, it would be idle to pretend that the parts of a watch, discovered by accident on a common, could have come together of themselves in harmonious correlation, so as to achieve the purpose of correctly measuring time, is it not still more idle to pretend that the vastly more numerous and complex adaptations discoverable in such an organ as the human eye or hand could have been brought about without the aid of an intelligent designer? It is true that certain considerations which were obvious enough in Paley's day, and had been so for centuries before, might have suggested a doubt as to whether this argument was conclusive—considerations as to the fashioning process which things undergo by simple contact with their environment, as when a man becomes polished by contact with society, or exposed surfaces hardened to resist the impact of external objects—but, speaking generally, neither the scientific nor the unscientific world was in a position at the time to deny in any effective manner the force of Paley's analogy.

To-day it is different. Father Zahm himself acknowledges that Paley's argument, examined in he light of the doctrine of evolution, becomes untenable. Things were not put together, once for all, by the divine artificer in the way the worthy dean imagined. As Topsy would say, they "growed" into those conditions of adaptation in which we at present behold them through the combined forces of heredity and natural selection—the former reproducing qualities once spontaneously developed, the latter rejecting forms not fitted to thrive, or at least less fitted than others to thrive, in their actual environment. The question, therefore, at present is, Can we assert with confidence, on the strength of some strong analogy such as that to which Paley—as is now evident erroneously—appealed, that the evolutionary process was set in motion with a distinct intention on the part of an intelligent Creator to produce precisely those forms and modes of life which prevail, and heretofore have prevailed, in the world? Adapted structures, it is conceded, exist, but is it certain that intention or purpose presided over their adaptation? On this question it does not appear to us that either Father Zahm or any of

his philosophical 'allies shed any light. An argument is attempted to be founded on the fact that the language used by Herbert Spencer himself in dealing with biological questions shows teleological implications; but there is nothing in this. Mr. Spencer is not a teleologist; and if he were, we should have to consider his reasons for being one, and not stop short with the fact that he was one. Science does not permit such an abuse to be made of authority. The reason why Mr. Spencer's language and all language has a teleological character is that man has been obliged to frame language on lines prescribed by his own mental activity. Man is essentially a designer, and he reads design more or less into everything that he sees.

There is one passage in our contributor's article which seems to evince that his conversion to the doctrine of evolution is not very complete. He remarks that it is "passing strange that those who are so prompt to deny the existence of purpose in Nature when there is a question of teleology, or when theological implications are suspected, are the very first to insist on the evidence of mind or purpose when in their own case it is demanded by the exigencies of argument or discovery"; and he cites as a case in point the conclusions founded by men of science on the discovery of "arrowheads and flint flakes in certain deposits whose age is indisputable." It is a great pity that Paley is not alive to congratulate Father Zahm on this neat application of his own method. The standpoint here is exactly that of Paley which we were given to understand had been abandoned. Arrowheads are not things that grow. The method of their production is known to us; and it is in the light of experience that we attribute their origin to human agency, and by the most necessary inference that we form conclusions as to the age of the human race from the situations in which such implements are found. But if, because we are obliged to recognize purpose in the manufacture of an arrowhead, we are equally obliged to recognize it in the first organic form presented to us, what need was there for amending Paley's argument? Our reverend contributor is making the whole work of Darwin of none effect by his traditions; and yet he preluded his argument by a general acceptance of Darwinism. We fear the new scientific baptism has not yet produced its full effect.

So once more we come round to the real point at issue. It is not disputed that evolution produces results which present a resemblance to the products of human design, in so far as the accomplishment of definite results by definite means is concerned; but where is the proof that mind has guided the action of evolution? Where is the proof that the products of evolution to-day are precisely the results that a superintending mind aimed at? Can Divine intention be quoted with any greater certainty in the "adapted" forms which survive than in the unadapted or less adapted ones that perish? We do not say that the teleological view is false; we only say that it requires to support it something more than a mere partial resemblance between the effects of evolution and those of purposive human action. We are far from quarreling with any optimistic creed or any religious interpretation of the universe; but it is right to protest when facts are put to a strain which they are not able to bear, and when consequently a scientific theory is in danger of losing its scientific value.

Our contributor speaks with disapproval of those who find "in the chance interaction of eternal force

and eternal matter an adequate explanation of all the problems of the existing universe." The man who finds in any scientific conception or hypothesis an adequate explanation of all the phenomena of the universe must be a somewhat fatuous being. Certainly this is not the usual attitude of the scientific mind. Mr. Spencer in particular, referred to by our contributor as "the great coryphæus of agnosticism," takes much pains to show that no adequate explanation of the phenomena of the universe is obtainable. What he has labored to do, for his own part, is to formulate the most general laws of world action which it is in his power to discover, and to show how more special methods of action are deducible therefrom. At the very basis of his system lies an unknowable power which does not admit of formulation. If we take the late Professor Huxley as one of the representative minds of the modern scientific world, we shall certainly not find him talking of having discovered an adequate explanation of all existing phenomena. It is one thing to decline the ready-made explanations of others, and quite another to claim to be in possession of a satisfactory explanation of your own. The mission of the man of science is not to explain the world in its totality, but to give those partial explanations of phenomena and their sequence which are needed to safeguard human life and fructify human effort. The man of science watches over the integrity of his own intellect, and refuses to allow it to be entangled in any yoke of bondage, knowing that he holds his faculty for truth in trust for the world. When he is asked to acknowledge "design" in this or that organism, he says: "I recognize the relations which this thing sustains to its environing conditions, and I have some limited knowledge of its previous course of development; but I do *not* know that it has become what it is through the application to it, or to the conditions under which it was produced, of any stress or influence proceeding from a conscious will such as alone furnishes to my mind the type of purposive action. A conscious will may well underlie this universal frame of things, but I can not, upon grounds of scientific observation, profess to be able to discern the presence or absence of its action at any particular point." This we conceive to be in substance the answer of Science to the question at issue; and it is one with which Theology would do well to be content, for Science will never knowingly make an affirmation which there are not facts to sustain.

Scientific Literature.

SPECIAL BOOKS.

In no way can one appreciate more clearly the remarkable advance in ethnographic studies than by comparing the great work of Professor *Ratzel** on *The History of Mankind* with the early works of Pritchard and Wood. The illustrated work of the Rev. J. G. Wood on the Natural History of Man represented the state of our knowledge on the subject at the time it was compiled, in a popular way to be sure, but nevertheless the

* The History of Mankind. By Prof. Friedrich Ratzel. Translated by A. J. Butler, M. A. New York: The Macmillan Company. 1897. Two volumes, pp. 486 and pp. 562. Price, $8.

reader had presented to him in a graphic way a light sketch of the habits, manners, and customs of the various peoples of the world. There were blunders, of course, such as classifying the Japanese with the uncivilized races! In the work of Ratzel we have a popular exposition of the subject from the same standpoint. It is a compact storehouse of facts, and the infinite lines of research shown in this remarkable compilation of data give one a just idea of the tremendous strides the science of ethnology has taken within a quarter of a century. A book bearing the indorsement of Professor Virchow and introduced to English readers by a prefatory chapter from the pen of Dr. E. B. Tylor must be one of importance and merit, and so it is. It has an unusually large number of illustrations of the weapons, utensils, toys, totems, etc., of all the races of the world. The portraits are derived from the very best sources, while maps and brightly colored plates make up a veritable ethnographic museum, and this feature alone renders the book indispensable to American students. Much of the material illustrated is derived from museums which have come into existence within recent times.

The work is so valuable that it seems an ungracious task to point out omissions. It is, however, necessary to call attention to the very evident fact that the author has derived his material almost exclusively from European sources. In that portion of the work dealing with the native races there are but few references to the work of American students. He shows no evidence of ever having seen the magnificent series of volumes issued by the United States Bureau of Ethnology, by far the most important of the General Government's publications. When one recalls the valuable contributions of Mason on the Throwing Stick; Cushing on Zuñi Fetiches; The Sign Language and Petrographs, by Mallery; Mortuary Customs, by Yarrow; Burial Mounds, by Thomas; Central Eskimos, by Boas; Point Barrow Eskimos, by Murdoch; Chiriqui Art in Shell and Pottery and other papers, by Holmes; Pueblo Architecture, by Mindeleff; Masks, Labrets, etc., by Dall; and the contributions by Powell, Stevenson, Henshaw, Matthews, Bourke, Hoffman, Mooney, Turner, Dorsey, McGee, Fewkes, and others which enrich these volumes, and a host of American workers in other lines of investigation, as Morgan, Bandelier, Mrs. Nuttall, Brinton, Culin, and many others, one realizes how clearly Ratzel has restricted himself to the work of European students. It is true many of these memoirs were not published when the first edition of this work appeared in 1884; but when the second German edition was published in 1895 most of these memoirs had appeared and many of them had been widely noticed in European journals, and the lavish generosity of our Government in the distribution of its publications must have placed them on the shelves of every leading library in Europe. The author in several instances confounds Japan with China by including both countries under certain general statements, and in one case the word Japan appears when it should read Java.

There is no evidence that the author recognizes the lowly origin of man. Dealing with the most pregnant facts as to man's evolution, he questions whether the savage is lower than other races considered civilized. For this reason perhaps the early stages of man are not considered, and therefore one must look elsewhere for the evidences of prehistoric man. Not a cranium or a human bone, unless it represents a trophy or a fetich, is given. It is true the work is for the general reader, but nowadays the general

reader, at least in America and England, demands much more than he did twenty years ago.

The work is so full of interesting material that it is impossible in a review of this nature to do more than quote here and there. An illustration of the persistence of certain traits in man is shown in the Tedas or Tebus, which are supposed to be the Troglodytes described by Herodotus. "They are to-day no poorer, no richer, no wiser, no more ignorant than they have been these thousands of years; they have acquired nothing in addition to what they possessed then." He shows in contrast the Europeans emerging from savagery in an exalted place among the peoples of the world. By such a picture do we see the persistence of conditions identical in every respect to those of the animals below us. While a form of Brachiopod may persist nearly unchanged from the lowest geological horizons to the present day, other forms of life may pass through rapid changes and become extinct. A group may go through slow and even changes like the ammonites of the Jura and finally culminate in rapid and extraordinary modifications in form.

In contrasting the inertness of the Chinese with the progressive European nations, he quotes Voltaire as "hitting the point" when he says that "Nature has given the Chinese the organs for discovering all that is useful to them but not for going any further." Peschel presents these contrasts in a clearer way perhaps when he says: "Of all highly civilized nations the Chinese owe least to foreign promptings, whereas until the thirteenth century we—that is to say the Europeans, and especially the northern Europeans—owed almost everything but our language to the teaching of other nations. . . . Since our intellectual awakening, since we have come forward as the propagators of the treasures of culture, we have indefatigably toiled with the sweat of our brows in search of something, the very existence of which was unsuspected by the Chinese, and which they would think dear at a platter of rice. This invisible object we term causality. We have admired the Chinese for an incalculable number of inventions and have appropriated them, but we are not indebted to them for a single theory or a single glance into the connection or the first causes of phenomena."

The statement is made that Chinese ships are said to have been cast away on the northwest coast of America. In every case the junks which have been cast away on our western coast or found drifting in the North Pacific are Japanese junks, not Chinese. A reference is made to glazed tiles associated with ancient pottery having been exhumed in the Mississippi Valley near Natchez. As a matter of fact the tile is post-Columbian.

The arrangement of cuts is somewhat confusing; they are not always found with the text. As the cuts are not numbered, there is no way of referring to them in the text. On the other hand, a good legend accompanies each illustration, and usually full credit is given to its derivation. References to special works on the subject treated would have added greatly to the value of the book. Thus on page 287, Volume II, the author says in speaking of the Hottentots: "If we may believe Kolb, the fortunate hunter undergoes an 'alterative process' at the hands of some old fellow-tribesman in the form of a hydraulic application which does not bear more minute description." Is he referring to Peter Kolben's remarkable work on the Present State of the Cape of Good Hope, an English translation of which

was published in 1731? A reference to Kolben's work would have given the student access to material which depicts the Hottentot before he had been seriously contaminated by contact with intrusive races, and would have explained the curious ceremonies connected with marriage and other rites and functions.

In regard to the dwarf tribes of Africa he says: "It is a pity that Stanley . . . has shown his usual tendency to exaggeration. With the dwarfs he has jumbled up children or misshapen beings such as negro chiefs keep at their courts for entertainment." Among the interesting generalizations is this one: "It has been correctly said that among negroes as elsewhere morality seems to stand in inverse ratio to the quantity of clothing, so that tribes that go naked are, so long as they remain untouched by foreign influence, the most chaste; those that are most clothed the least so." The missionaries can not or will not see the significance of this truth, and instantly demand a sudden change in habits engendered under a tropical sun, with the inevitable result of physical and moral degeneration of their converts.

His treatment of the African races is by far the most exhaustive, and the mass of new material in statement and in illustration will be of the greatest value to the American student.

GENERAL NOTICES.

THE important question of memory and its cultivation is the subject of the last volume in the International Scientific Series to reach us.* What memory is, its place and importance in the economy of the human mind, its divisions and special functions, and, finally, methods for its cultivation, is the ground covered by Mr. Green's book. The great importance of a good memory is manifest; in fact, our intelligence depends almost entirely on the ability to remember what we learn, or, more accurately, what we perceive, as learning a thing implies the use of memory, so that any suggestions which may help to improve our ability to remember are worthy of close attention. Mr. Green says that in his own case, after a use of the methods he recommends, he found that he could learn a subject in about a fifth of the time that it previously took him. The special rules for memory cultivation occupy only the last fifty-five pages, although the whole subject is treated with special reference to this aspect of the question. The rules are simple, and, in fact, those which common sense would dictate—such as concentration of attention on the subject which it is desired to remember; the exclusion of unimportant and confusing details; frequent recalling of the impression; the use of as many faculties as possible in fixing the original impression; studying when the nervous force is abundant, etc.

When the political uncertainties of the scientific departments at Washington are considered, it seems really remarkable that anything at all is accomplished by them. For the successful prosecution of original research freedom from the petty cares of political maneuvering would seem essential, and yet some of these sections, notably the ethnological and geological, are constantly turning out valuable material. The last of their publications to reach us are a number of Geological Survey bulletins.* The first one, No. 87, is by Charles Schuchert, and gives a synopsis of the American Fossil Brachiopoda, including a valuable bibliography and synonymy. The richness of North America in well-preserved Palæozoic brachiopods gives Mr. Schuchert's work a special interest. No. 127, by N. H. Darton, is a catalogue and index of contributions to American geology, and while there can be little said of it in the

* Memory and its Cultivation. By F. W. Edridge-Green. New York: D. Appleton and Company. Pp. 307. Price, $1.50.

* Department of the Interior. Recent Bulletins of the United States Geological Survey. Nos. 87, 127, 138, 139, 140, 141, 142, 144, 145, 146.

way of a review, the value of a carefully prepared bibliography of geological literature as a reference book for libraries and geological writers can not be overestimated. No. 138 is entitled Artesian Well Prospects in the Atlantic Coastal Plain Region, and is by the same author as No. 127. It seems that in this region of the Atlantic slope there are no large supplies of potable surface water. Fortunately, however, it has a geologic structure particularly favorable to the accumulation and flowage of underground waters, and from these underground streams several cities at present obtain their water supply. Mr. Darton tells us that during the past six years he has been engaged in a geological study of this coastal plain region, and has given especial attention to the question of subterranean waters; and while this investigation is as yet very imperfect, he thinks that it will in a measure meet the great demand for information as to well prospects and the general relation of the water horizons. In No. 139 Messrs. Weed and Pirsson give us a general study of the geology of the Castle Mountain mining district of Montana. No. 140 is a report of the progress made in the division of hydrography in the calendar year of 1895. The author is F. H. Newell. The Eocene Deposits of the Middle Atlantic Slope in Delaware, Maryland, and Virginia, A Brief Contribution to the Geology and Paleontology of Northwestern Louisiana, The Moraines of the Missouri Coteau and their Attendant Deposits, and The Potomac Formation in Virginia are the titles of the next four bulletins. No. 146, by F. B. Weeks, is a Bibliography of North American Geology, Paleontology, and Petrology and Mineralogy for 1895. No. 147 is a record, by C. D. Perrine, of the earthquakes occurring in California in 1895, of which there seem to have been about fifty. Messrs. Clarke and Hillebrand, in No. 148, publish some analyses of rocks and analytical methods used in the United States Geological Survey between the years 1880 and 1896.

In *The Social Mind and Education*,* by *G. E. Vincent*, an effort is made to bring conceptions from social philosophy to bear upon the problem of education, with the hope that there may result both clarification of ideas and greater definiteness of purpose. Stress is laid chiefly upon the cognitive function of society and of the individual. Such one-sidedness of treatment is adopted, not from any failure to recognize the organic unity of the mind, but because the vastness of the general subject precludes its treatment in a single volume. The parallel between the development of the race and the individual has of late been subjected to criticism. "It has been pointed out that there are short cuts by which in individual evolution whole stages of the race's growth may be omitted. . . . Education sets before itself the task of relating the individual intrinsically to the social tradition so that he may become an organic part of society. . . . It should be therefore a definite aim of the higher education to direct the student in a purposeful integration of his various pursuits, a putting back of these abstractions into a concrete conception of life."

Dr. *Shufeldt* has at last brought together in one volume* the majority of his popular scientific papers on *Natural History*. Most of the material has already appeared as magazine articles, and hence does not form a systematic treatise, but is rather a series of Nature stories selected at random, and ranging from the cedar bird to the polar bear. Technical descriptions are avoided, and the text has been prepared chiefly with the view of stimulating the unscientific to an interest in the common forms of animal life which are so abundant and interesting, and which usually receive so little intelligent attention from the average country stroller. The first two chapters deal with methods of study and the classification of animals, and serve as a sort of introduction to the main portion of the book. There is also a final chapter on museums and their uses. This class of books on popular natural history has been enormously increased of late, and while even the poorest of them have some value, a new one in order to justify itself ought to have special claims to originality, and in order to be of scientific value, some system in

* The Social Mind and Education. By George Edgar Vincent. New York: The Macmillan Company. Pp. 155. Price, $1.25.

* Chapters on the Natural History of the United States. By R. W. Shufeldt. Illustrated. New York: Studer Brothers. Pp. 472.

its treatment of the various groups. This volume is unfortunately devoid of the latter qualification, but does contain a number of reproductions from actual photographs of the living forms; some of them actually very good and others very bad, but all of them remarkably good when one considers the great difficulties in the way of photographing the living animal in its native woods. These pictures and Dr. Shufeldt's facility in presenting scientific facts in a readable and entertaining form no doubt help to justify the book.

The State Geologist of Indiana, *W. S. Blatchley*, informs us, in his *Twenty-first Annual Report of the Department of Geology and Natural Resources*, that abandoning, for the most part, "the unscientific method of county surveys, which is impeded by artificial boundaries having no relation to geological conditions," he has adopted that of taking up each of the great natural resources of the State, and preparing a monograph thereon, based upon actual field investigation. The present report contains papers by him and his assistants upon the natural resources of the State, the petroleum industry, composition of coals, the Black Slate or Genesee Shale of New Albany, Indiana Caves and their Fauna (finely illustrated), the Geology of the Middle and Upper Silurian Rocks of Clark, Jefferson, and neighboring counties, the Bedford Oölitic limestone (the famous building stone), natural gas, mines, oils, the geology of Vigo County, and the uncultivated ferns, fern allies, and flowering plants of the same county. The report is illustrated by maps and plates.

A lecture on *The Protestant Faith, or Salvation by Belief*, read on various occasions before the Young Men's Christian Union by *Dwight Hinckley Olmstead*, is published by G. P. Putnam's Sons, with an introduction on the Limitations of Thought. It is a criticism of the Protestant principle of freedom in thought, and maintains that belief is involuntary, and therefore compulsory.

In preparing the second edition of his book on *The Psychical Correlation of Religious Emotion and Sexual Desire*, the author, Dr. *James Weir*, has incorporated in it a considerable amount of additional evidence in support of his theory, has verified all references, has endeavored to eliminate unnecessary material, and has divided the work into three parts. He has also added to the volume several other essays in which psychical problems are considered. Of the main work, the first part relates to the origin of religious feeling, which is believed to have been first material and prompting to propitiatory offerings. The second part is devoted to Phallic Worship, which, the author argues, dates from a very early period, has been universal, and has survived, even in some parts of Europe, in one form or another, to a very recent period; and the general subject, as defined in the title of the book, is treated in the third part. Dr. Weir's theory was first announced in a medical journal in New York in 1894; the first edition of this book was printed in June, 1897, and the second edition was all written and in the hands of the publishers in August, 1897—all before another book on the same subject appeared, in October, 1897.

The King's Daughter and the King's Son, "a fairy tale of to-day," by *Agatha Archer*, was written, as we learn from the title-page, by a King's Daughter in the summer of 1896. It declares its part to be "to conspire with the new works of new days." It presents subjects of vital social relations from a new point of view, and aims to enforce the precept that women should be given time and opportunity before marriage to understand clearly what marriage means to them. (Fowler & Wells Company, publishers. Price, $1.)

Physical Problems and their Solutions, by *A. Bourgougnon* (D. Van Nostrand Company's Science Series), presents a number of problems classified under the headings corresponding to the different divisions of physics to which they are related, and prefaced by such explanations as render their meaning clearer; also problems which have been set at examinations by the University of the State of New York. The solutions of some of the problems are given, and in cases where similar problems have already been treated, references to such solutions have been made.

The author, *D. K. Tenney*, of a paper entitled *The Cooling Universe Refuted: the Earth not Born of the Sun*, aiming to awaken inquiry on the subjects treated of, seeks to

show that current theories of the origin and history of the earth and solar system are wrong; that the sun does not project light and heat as such to the earth; that the earth is not a result of nebular evolution, but is self-existent and independent, as are other planets and systems, and along with the other bodies is a great electro-magnet; and that the forces of that category developed by these bodies are the power behind all phenomena. His argument consists of variations of the familiar one that the present explanations—accepted for want of better ones—are unsatisfactory. His electro-magnetic idea—perhaps not intrinsically objectionable as a general principle—still leaves the why and the how unaccounted for.

A book by Dr. *Frank Wood Haveland* (published by the author, 205 West 118th Street, New York, $2), entitled *Science, the Ancient Hebrew Significance of the Book of Genesis*, is a little bewildering to one not initiated into the mysteries of Christian science. The book of Genesis is described as the foundation of all other books of the Bible and of every science, philosophy, and religion of all ages, and as explaining various biblical and human mysteries, including the science of healing of the sick, and revealing the highest conditions of thought. In connection with the authorized version of Genesis, a paraphrase is published, embodying its supposed hidden meaning.

The poem of *Josiah Augustus Seitz*, entitled *The Colloquy*, is further designated on the title-page as Conversations about the Order of Things and Final Good, held in the Chapel of the Blessed St. John, summarized in Verse. The conversations cover a considerable part of the field of philosophy and knowledge, and relate to subjects, some of which, as in the tenth conversation, "The World of Wrong and Pain," bearing on the social aspects of life; the twelfth, "Of the Natural Order," setting forth evolution; and the thirteenth, "Excursion to Mars," relating to cosmogony, bear on subjects coming within the purview of science. (G. P. Putnam's Sons. Price, $1.75.)

Certain underground structures found in some of the ruined groups of Yucatan have excited the curious attention of explorers, but have not been satisfactorily accounted for. They are generally single chambers, resembling vaults in appearance, built ten or fifteen feet below the surface, and having no connection with the outer world except a single opening through the roof. They are particularly noticeable at Labná, and several have been found at Uxmal. Thirty-three of these *chultunes*, as they are called, at Labná have been explored by Mr. *Edward H. Thompson*, whose report upon them, *The Chultunes of Labná*, is published as a Memoir of the Peabody Museum of Ethnology and Archæology. Mr. Thompson found in them much dust, flint implements, potteries, and human bones. He believes that they were primarily built and used for the storage of water in a region where that necessary is very scarce and hard to get, and that some of them were afterward converted into tombs.

Suggestions for laboratory and field work in *High-School Geology*, by *Ralph S. Tarr*, is intended as an aid for the teacher. It is an attempt to introduce the object-lesson method into the study of geology, and, while there can be no question of its desirability and efficacy, there are many difficulties in the way of its adoption in the ordinary high school, the chief among which are lack of time and adequate knowledge by the teacher. The subject is taken up chapter by chapter (following the author's Elementary Geology), field and laboratory work being introduced wherever it seems called for. The latter half of the volume consists of a series of questions for use with the author's Elementary Geology. (Macmillan, 25 cents.)

The elementary course in comparative anatomy of the vertebrates includes, in many colleges, the thorough study of some readily obtained, characteristic vertebrate, followed by studies of the various types. Prof. *David S. Kellicott*, of the Ohio State University, finds that in the preparation of literary guides for these dissections, the Ophidian, or snake, has been omitted. Considering it as really an important and agreeable type, and easily obtained in the spring, he has undertaken to supply the omission with a little handbook on the *Dissection of the Ophidian*. The Spreading Viper (*Heterodon platyrhinus*), a common, harmless snake of fair size, is taken as the type for examina-

tion. The systematic place and external characteristics of the *Ophidia* are first explained, and then follow chapters on bones, muscles, and the digestive and vascular systems and special sense organs, and brief explanations of methods are given in appendixes. (Published by the author, Columbus, Ohio.)

Another of Appletons' Home-Reading Books is *Harold's First Discoveries*, in the Nature-Study series, by *J. W. Troeger*, designed for younger children. Harold observes what he sees, or at times goes out to see, and learns or is told about the dispersion of seeds like those of the milkweed, dandelion, thistle, etc., trees, fruits, vapor, frost, the magnet, metals, crystals, animal life, and budding and germination as illustrated in the willow, lilac, beans, and peas. The works in these series are furnished with practical hints as to the way the subjects may be dealt with in the teachers' guidance of their pupils, so as to awaken the most lively interest and contribute to real knowledge of them.

An account of *Certain Aboriginal Mounds of the Georgia Coast*, published by *Clarence B. Moore* in the Journal of the Academy of Sciences of Philadelphia, gives the result of five months' continuous work in the mounds along the coasts of the inland water passage, in the course of which twenty-one of them were examined. Remarks on the methods of burial observed in these mounds and in those of Florida—"bunched" and "flexed"—the burial of infants and burials in baskets and in jars, precede the accounts; attention is called to some rather marked differences in custom and practice found to have prevailed in the region and in Florida, and even in close neighborhood with one another. A chapter is added on Inhumation and Incineration in Europe, by the Marquis de Nadaillac. The paper is illustrated by figures in the text and fifteen excellent large plates.

Dr. *M. L. Holbrook* is of the opinion that "the time has come for man to take special interest in his own evolution, to study and apply so far as possible all the factors which will in any way promote race improvement." As a contribution to this study he offers his book on *Stirpiculture* (M. L. Holbrook & Co., New York, $1). We are not yet able, he admits, to apply perfectly all the factors that will promote race improvement, but we can make a beginning; "greater thoughtfulness may be given to suitable marriages; improved environment may be secured; better hygienic conditions taken advantage of; food may be improved; the knowledge we have gained in improving animals and plants, so far as applicable, may aid us; air, exercise, water, employment, social conditions, wealth and poverty, parental conditions, all have an influence on offspring, and man should be able to make them all tell to the advantage of future generations." These topics are discussed in so far as they bear upon the main question.

Mrs. *L. L. W. Wilson's* manual for teachers on *Nature Study in Elementary Schools* (the Macmillan Company, New York, 90 cents) is characterized by the editor, Francis W. Parker, as "an outgrowth of a rich, varied, and thoughtful experience with child nature and the nature that surrounds the child." The manner and atmosphere of the book justify the characterization. The method has been tested in the schoolroom with excellent results. It is planned to meet the needs of the ordinary grade teacher in the public schools of a city. It does not presuppose special knowledge on the part of the teacher, or special facilities for the collection of material, but earnestness in his work and all that pertains to it. The system is substantially an object-lesson system, and should be assisted by class excursions for material. The excursions of the author's class were made into the street, in Philadelphia.

To their valuable and attractive series of Home Reading Books, Messrs. D. Appleton and Company have added *The Hall of Shells* (price, 60 cents), in which the young reader is introduced by the author, Mrs. *A. S. Hardy*, to the beauty and wonderful structure of mollusks and the habitations they construct for themselves. The characters in a simple story wander along the seashore gathering shells, or find them in their aquarium and converse freely about them—their forms, colors, peculiarities of structure, and the animals that inhabit them—under the guidance of one who has some scientific knowledge of them. In this way enough informa-

tion is brought in to give a fair degree of general knowledge concerning the animals or families under study, and the reader is referred for further facts to accessible works which give them. Thus the reader is taught concerning the more common shells, the mythologies and literature concerning them, their microscopic structure, pearls, seaweed, the nautilus, the Medusæ, echinoderms, the Gordonidæ, the work of mollusks, the fate of shells, the use of the dragnet, etc.

Another, a little larger book of the Home-Reading Series, is *Uncle Sam's Secrets* (75 cents), the purpose of which is defined by the author, *Oscar Phelps Austin*, "to be to furnish the youth of the land some facts about the affairs of the nation, and to awaken in the mind of the reader an interest in kindred subjects." In this book, too, a thin thread of a story and the conversations of the characters in it are made the vehicle for conveying instruction about different kinds of Government money, the postal service, American geology, the mint, the courts, the navy, bimetallism and monometallism, the history of the currency, the tariff question, the history of parties, and the presidential electoral system. Copious references are made to the books in which further information on those subjects may be found.

Among the great variety of information on the special subject given by the *Scovill and Adams Company* in their *American Annual of Photography and Photographic Times Almanac* for 1898 (price, 75 cents), we single out for mention the contributed articles conveying instruction as to methods and processes or relating experiments and experiences—the chemical tables, the descriptions of the novelties of the year, the standard formulas and useful recipes, tables for the simplification of emulsion calculations, tables of comparative light values, the list of principal chemicals, photographic schools, list of photographic books published in 1897, the record of photographic patents, lists of American and foreign photographic societies, and a list of hotels having dark rooms for development. Numerous plates and pictures represent photographic work of rare excellence, or illustrate the text.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. New Hampshire College, Durham: No. 47. Strawberries. By F. W. Rane. Pp. 24.—New Jersey: No. 126. Small Fruits. By Alva T. Jordan. Pp. 32; Bovine Abortion, Milk Fever, and Garget. By Julius Nelson. Pp. 24.—New York: No. 130. Popular edition. A New Disease of Sweet Corn. Pp. 5; No. 131. Popular edition. Oat Smut and New Preventives. Pp. 6; No. 132. Popular edition. Milk Fat from Fat-Free Food. Pp. 6. All by F. H. Hall.—Ohio: Newspaper Bulletin. No. 180. The Sugar-Beet Tests of 1898. Pp. 1.—United States Department of Agriculture, Weather Bureau: An Improved Sunshine Recorder. By D. T. Maring. Pp. 15.

American Academy of Political and Social Science. The Economic Relation of Life Insurance to Society and State. Addresses by various persons at the meeting, December 17, 1897, Philadelphia. Pp. 48. 25 cents.

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Fragments of Science.

The Origin of Coral Island Forms.—This much-discussed question has been raised again by the boring operation of Professors Sollas and David at the island of Funifuti. Their results, as far as they have been announced, seem to confirm Darwin's theory of subsidence. But now we have a letter (American Journal of Science, February, 1898) from Alexander Agassiz, who is at present with a scientific expedition in the Fiji Islands, announcing observations which seem to point toward elevation rather than subsidence. Professor David's bore hole at Funifuti was carried down six hundred and ninety feet, and a preliminary examination of the core indicated that the reef had been built up in the immediate neighborhood, at any rate, of growing coral. Portions of true reef were found in various positions throughout the whole depth. There seems, however, to be a possibility that the boring was situated on a very steep slope of volcanic rock, covered by a talus of coral *débris* from a reef on the summit. A further and fuller report from Professor David will no doubt clear up some of these uncertainties. The material received from Mr. Agassiz is only that contained in a private letter. Much to his own surprise, he found the general appearance of the islands to indicate, if not prove, that elevation rather than subsidence had taken place. After recalling Professor Dana's statement of the beautiful illustration which the Fijis gave of the gradual changes brought about by subsidence, he says: "My surprise was great, therefore, to find within a mile from Suva an elevated reef about fifty feet thick and a hundred and twenty feet above the level of the sea, the base of the reef being underlaid by what is locally called soapstone, probably a kind of stratified volcanic mud." Many other traces of extensive elevation were noted. At Tarutha, for instance, the coral limestone bluffs were probably eight hundred feet high. From a series of such observations Mr. Agassiz "is inclined to think that the corals of to-day have actually played no part in the shaping of the circular or irregular atolls scattered among the Fiji Islands; furthermore, that they have had nothing to do in our time with the building up of the barrier reefs surrounding either wholly or in part some of the islands. I also believe that their modifying influence has been entirely limited in the present epoch to the formation of fringing reefs, and that the recent corals living upon the reefs, either of the atolls or of the barriers, form only a crust of very moderate thickness upon the underlying base.

This base may be either a flat of an eroded elevated reef or of a similar substructure of volcanic rocks, the nature of that base depending absolutely upon its character when elevated in a former period to a greater height than it now occupies. . . . The Fijis are not situated, as was supposed, in an area of subsidence, but on the contrary, they are in an area of elevation, so that the theory of Darwin and Dana is not applicable to the islands and atolls of the Fiji group." As it was a study of these and similar groups which led Darwin and Dana to adopt their theory of subsidence, Mr. Agassiz seems to dispose of the theory as applied to any islands, although he says in a later paragraph, "The great variety of causes which have been active in shaping the present physiognomy of the reefs and atolls of Fiji shows the impossibility of assigning any one factor . . . as the single cause for the formation of the many different kinds of atolls and barrier-reef islands to be found in the Fiji group." Mr. Agassiz promises a fully illustrated report some time during the coming summer.

New Theories regarding the Rainbow.—The old theory of the rainbow, which is still found in optical text-books, only imperfectly accounts for the true bow and fails entirely to explain the "spurious bows" which often accompany the former. It is usually possible by close examination to distinguish certain colors on the inside edge of the primary which are not consistent with the simple series of spectrum colors, accounted for by the Descartes theory. In a paper on The Intensity of Light in the Neighborhood of a Caustic, Airy seems to have laid the foundation for an adequate theory of the rainbow. An article in Nature on this subject says that Mr. J. M. Pernter is working out the new theory, and his general conclusions are given as follows: "The greater the drops the more spurious bows." A chief bow of intense pink and green (hardly any blue) indicates drops of diameters ranging from one to two millimetres; intense red always speaks for big drops. Secondaries (spurious bows) of green and violet (the blue is marked by contrast) without yellow, immediately forming the chief bow, correspond to drops of 0.5 millimetre, while five and more secondaries without white and without breaks mark drops of 0.1 millimetre. A partly white bow is produced by drops of 0.06 millimetre, and when the drops are still smaller, a real white bow with orange-yellow and blue margins is the result. The net result of these elaborate investigations will be to add a new interest to a natural phenomenon already endowed with many associations of magic and beauty."

The Recent Total Eclipse of the Sun.—While there have been no complete reports from any of the observation parties of the total eclipse of the sun of Saturday, January 22, 1898, enough information has been received to indicate that the majority of them were successful and that much data of extreme scientific value has been obtained. The only district in which the weather was not propitious seems to have been southern Russia, only a few good photographs being obtained. A telegram received from the Rev. J. M. Bacon, in charge of the British Astronomical Association at Buxar, announces perfect weather and "observations satisfactory all round." This party is reported to have taken a successful series of cinematograph pictures. The party located at Jeur, from the Lick Observatory, under the direction of Prof. W. D. Campbell, reports very successful observations. The unusually favorable weather, the number of trained observers on the ground, and the delicate and powerful instruments at hand, have evidently combined to make this one of the most important scientific events in the closing years of the century. In calling attention to this fact Nature says: "With such a list of successes we may safely say that this eclipse, as befitting the last one of the century, has surpassed all previous records; but, unlike many eclipses at the beginning of the century, it can not be truly said that the event of Saturday was over at the end of two minutes of totality. To many the eclipse has yet to begin and will last for many months, during which time each line in the spectrum, each streamer of the corona, each prominence on the sun, will be analyzed little by little to discover if we have similar streamers in other coronas or identical lines in our laboratories. It may be confidently expected that the results obtained

on Saturday will enable us to solve some of the enigmas of solar phenomena and constitution."

Source of the X Rays.—Professor Trowbridge, of Cambridge, and J. E. Burbank have recently published (American Journal of Science, February, 1898) the results of an investigation into the source of the X rays. The experiments were conducted with Crookes tubes containing no interval between the anode and cathode, so that no discharge in the usual sense occurred in the tubes. A continuous conductor was led through the rarefied tube, and it was discovered that X rays were given off from every element of this conductor at right angles to its surface when a disruptive discharge occurred in the circuit of which the tube formed a part. This remarkable result was obtained by means of the very high electromotive force from a Planté rheostatic machine which was charged by ten thousand storage cells. Among the interesting data obtained were some regarding the so-called Xray burn. When the back of the hand was exposed to the brush discharge from one of these tubes, a peculiar pricking sensation was experienced and all the symptoms of an X-ray burn developed. The skin when examined under a microscope exhibited centers of inflammation surrounded by regions of lesser degrees of burn. It thus seems evident that the so-called X-ray burn is due to an electrification—a discharge at the surface of the skin—and this electrification may or may not be accompanied by the X rays. The results of the experiments are summed up as follows: 1. A Crookes tube inclosing a continuous conductor is well suited, with the employment of high electromotive force, for the study of electric lines of induction. 2. The direction of the so-called X rays and cathode rays can be changed by electric induction. 3. The so-called X-ray burn can be produced by an intense state of electrification. 4. The so-called cathode rays and X rays are given off from every element of a continuous conductor at a high stage of the vacuum in a Crookes tube, both when this conductor constitutes the cathode and when it forms the anode of the electrical circuit. The term electric rays, possibly rays of polarization, would appear to be more comprehensive than the terms cathode rays and X rays.

Early Observations of the Zodiacal Light.—Apparently the earliest mention of the zodiacal light is a notice by Diodorus Siculus, of the appearance in the sky, in B. C. 373, "of a great light for several nights, which was called, from its shape, the burning beam." Nicephorus, in his Ecclesiastical History, tells of a remarkable appearance in the sky for a considerable time during the summer and fall of A. D. 410, which he thought could not be a comet, because it had not a stellar nucleus. Cassini saw a similar phenomenon in March, 1668, and his nephew Maraldi another in March, 1702; but Cassini's observation was of a comet, the head of which was not visible to him, while it was seen in the East Indies and at the Cape of Good Hope. The first person to give a definite description of the zodiacal light was Joshua Childrey, who is quoted by W. T. Lynn in the Observatory as saying that "in *February*, and for a little time before, and a little after, that month (as I have observed several years together), when the Twilight hath almost deserted the *Horizon*, you shall see a plainly discernible ray of the Twilight striking up toward the *Pleiades* or seven stars, and seeming almost to touch them. It is to be observed any clear night, but is best *illuc nocte*. There is no such ray to be observed at any other time of the year (that I can perceive), nor any other ray at that time to be perceived darting up elsewhere. And I believe it hath been and will be constantly visible at that time of the year. But what the cause of it in nature should be, I can not yet imagine, but leave it for further inquiry."

The Importance of Public Baths.—Some interesting statistics are given by Walter Channing regarding the municipal public baths of Brookline, Mass. The baths were opened in January, 1897, and at the time Mr. Channing's article was written, about the middle of May, there had used the baths 17,089 bathers, or an average of 451 daily. A somewhat curious difference was noted between the number of males and females. The bathers during the last six weeks, for instance, being divided as follows: Men and

boys, 3,813; women and girls, only 1,080. When the baths were first opened the policy was to have as many free days as possible, but it was found quite impossible to keep order even with the aid of a police officer. Under a new arrangement by which a fee of five cents was charged, which included soap, towels, and bathing dress, a great improvement was manifested, even this small fee seeming to make the bathers more self-respecting and conscientious and doing away with that irresponsible and reckless feeling which an unadulterated charity seems so prone to produce. Instead of the fees decreasing the number of bathers, there was a constant and steady increase. An interesting experiment in connection with these baths is the giving of instruction in swimming to the public-school children. The town pays for this through the school committee. The pupils as well as the teachers have taken great interest, and already large numbers have been taught how to swim. At the end of the school year there will be thorough tests, and certificates of proficiency will be given. Aside from the value which this bath has as a swimming school and healthy recreation ground for the children, its successful continuance can not fail to have a most beneficial effect on the general personal cleanliness and sanitation of the town, a clean individual being much less patient with nasty streets and houses and neighbors, than a dirty one. The importance of the public bath does not seem to be generally appreciated in this country. It is when properly handled one of the most powerful and far reaching of the municipalities' institutions for promoting cleanliness, both mental and physical, and good citizenship; in several of the European states where this fact has been appreciated the public baths of the cities and towns are among their most important institutions.

Industrial Instability in Russia.—Industrial labor in Russia, as pictured in the bulletin of the *Musée Social*, is usually unstable and can not be depended upon. In most of the shops the workmen scatter at once in the spring. The operatives who come in after the Easter vacation, which lasts several weeks, are generally new ones, who have never worked in that kind of industry, and a new apprenticeship is necessary. Hence arises an obstacle to the development of professional skill. The new hands are very awkward, and are more quickly tired than those who are accustomed to work methodically. The workman is continually changing his place, and passes from one trade to another, as he would from one place to another, becoming now a shop operative and now an agricultural laborer. As M. Anatole Leroy Beaulieu says, he is a nomad. He is not identified with his machine, does not understand it, and does not know how to bring out its latent power. Hence in many industries which have been long organized on the grand scale in the West, the Russian does better work at home in the old way than can be turned out in the factories. Besides this, the Russian working class takes to machines with a bad grace, and will not use them except under compulsion. A curious condition, resulting partly from this disposition, is that when crops are good and the demand for manufactured products is lively, the workmen abandon the shops because they can live without the labor. It is of no use to raise wages, for that offers no attraction to the peasant who has enough to live upon in his usual way. While in the West the best-fed workman is the most efficient, in Russia the one who is satisfied is the most idle. Where women are found in the shops, it is an indication of improvement and of better development and more stable conditions.

Defects of the Metric System.—An admirable summary of the arguments against the enforced adoption of the metric system of weights and measures is presented by Mr. George W. Colles, in a paper read by him before the American Society of Mechanical Engineers. Having examined what has been said in favor of the system and against it, he concludes that the claim for its scientific accuracy is not justified, none of its units being what it purports to be; that the metre, as a scientific standard, can claim no superiority over the yard, and leaves us, moreover, without that most useful of measures, the foot; that while uniformity, carried too far, is of doubtful advantage, the metric system in practice has generally served not to introduce but to destroy it, by superadd-

ing new methods without replacing old ones; that the decimal divisions, instead of being the greatest advantage of the system, are its most irreparable defect, and of whatever uniformity of division Nature and man are capable, it can never be expressed by the number ten; and that the mind can never think in decimal fractions, but invariably does think in fractions reduced to their lowest terms, so that they are as impossible to get rid of as the mind itself. The English system, the author shows, though, like all things in Nature, it bears the marks of imperfection, the decay of time, and the usages of civilizations long since passed away, yet in its essential elements embodies the wisdom and experience of ages, and is, in fact, the survival of the fittest.

English Composition "as it is Taught." —An idea of the value of instruction in English writing given in our common and preparatory schools may be gained from the report of the Committee on Composition and Rhetoric to the Board of Overseers of Harvard University. The committee gave out as a subject to the students for voluntary composition a description of the instruction and what they thought it was worth. Thirteen hundred and eight students in the college, Scientific School, and Radcliffe College handed in papers. These are classified and compared according to the advancement of the writers in the college course. The most noticeable feature in the papers corresponding with the freshman grade, taken as a whole, is their extreme crudeness of thought and execution; and they reveal various defects in the system of instruction used in the schools from which the writers came. The papers of the next grade were better and showed benefit from instruction received in the previous course, but with evidence of the deficiency in early elementary training still apparent. The work of the writers of the junior class (average age twenty-one years) was satisfactory, but nearly all of them expressed a decided opinion that the instruction given in the preparatory schools in written English is inadequate. All but three of the seventy papers from Radcliffe College were creditable in execution; but none of them indicated any special capacity for observing, or attempted anything in pointing out defects which might be termed a thoughtful solution of them. The papers from the Scientific School were, curiously, "noticeably inferior in nearly all respects." The papers from graduates of normal schools were likewise not what could be reasonably expected from students of such institutions. The chief value of these papers "lies in the indirect or unconscious light they throw upon a curiously heterogeneous system of almost undirected natural growth." They also reveal "what heretofore has been the great defect in the methods of instruction in written English in the common preparatory schools. It has been taught almost wholly objectively, or as an end; almost never incidentally and as a means." In the great majority of these schools "English is still taught, it would seem, not as a mother tongue, but as a foreign language." The committee believes, however, that, taken as a whole, the inferences and conclusions to be drawn from the papers "are distinctly and unmistakably encouraging, because they reveal wherein is to be found the root of the trouble, and indicate the steps now being taken to remove that trouble. It is remarked that while methods of instruction are often unsparingly criticised, schools and teachers are, as a rule, kindly spoken of.

The International Scientific Catalogue. —The proceedings of the International Bibliographical Conference of 1896 in London concerning the International Catalogue of Scientific Literature, Dr. Cyrus Adler's summarized account of which has only recently been published, afford many points of interest. Among them was the discussion as to the definition of a contribution to science for the purpose of the catalogue. It was decided, with the help of a committee to which the conference had to refer the subject, to mean a contribution to the mathematical, physical, or natural sciences, "such as, for example, mathematics, astronomy, physics, chemistry, mineralogy, geology, botany, mathmatical and physical geography, zoölogy, anatomy, physiology, general and experimental pathology, experimental psychology, and anthropology, to the exclusion of what are sometimes called the applied sciences—the limits of the several sciences to be determined hereafter." The discussion related

not so much to the subjects that should be included, as to the terms under which they should be described and classified. It was further decided, without dissent, that in judging whether a publication is to be considered a contribution to science suitable for entry in the catalogue, regard should be had to its contents, irrespective of the channel through which it is published." The importance of this rule was emphasized by several German delegates, some of whom pointed out that trade journals, and even a daily paper which was named, often contain scientific articles of great value. Those who are disposed to ridicule "newspaper science" must hereafter qualify their flings. Regard is to be had first in the catalogue to the requirements of scientific investigators; entries are to be both by subjects and by authors' names; the catalogue is to be issued by a central bureau to be located in London, with the Royal Society advising, and in English, with authors' names and titles in their own language; and to be begun January 1, 1900. The English (including American) element was influential in the conference, and none of the delegates had more force in its deliberations than the American representatives, Prof. Simon Newcomb and Dr. J. S. Billings. The American department of the catalogue will be under the direction of the Smithsonian Institution, and an appropriation of ten thousand dollars is asked from Congress to carry on the work.

A Musical Experiment.—A somewhat interesting musical experiment was recently made by Prof. E. E. Slosson, of the University of Wyoming. Twenty-two persons—seven men and fifteen women—each provided with paper and writing materials, were given a pianoforte concert, and at the expiration of each piece were requested to write down the impressions received from the music. Only one of the twenty-two was a professional musician. The pieces played were: *a*, Chopin funeral march (sonata, op. 35); *b*, S. F. Powell nocturne, Hope (op. 4, No. 1; *c*, S. F. Powell nocturne, Solicitude (op. 3, No. 2); *d*, Handel's aria, He was Despised and Rejected of Men (The Messiah); *e*, Chopin nocturne (op. 15); and *f*, Schubert, Liszt Serenade. The conclusions drawn, from an examination of the answers returned, seemed to show that music has a somewhat definite emotional content, and that impression of this is received by the average listener, but with varying intensity. The formal content seems to be furnished entirely by the mood, associations, or temperament of the individual. A great difference exists both in the capacity of individuals to receive definite impressions and of composers to convey them. To overcome a strong individual mood requires music of extremely strong expressiveness.

Ice Caves.—Three principal forms in which ice enduring all the year round is found are mentioned by Mr. Edwin Swift Balch in his paper on Ice Caves and the Causes of Subterranean Ice: glaciers, ice gorges, and ice caves. Glaciers are formed from the winter snows, which by their own weight, and melting and regelation, have accumulated into a mass of ice. Ice gorges or gullies occur in fissures or ravines, at an altitude greatly below the general snow line of the district, where the winter snow is sufficiently protected from the sun to endure as snow or ice through the summer months. The author has, for instance, found lumps of ice in King's Ravine, on Mount Adams, in the White Mountains, among the big bowlders, late in September. The ice in such gullies is formed in the same manner as that of glaciers, or that on ponds and rivers, by the cold of winter and the melting of the snows. Ice caves are roofed, and the ice is formed directly within them, and is not, except perhaps near the entrance, solidified snow. The roof, while not admitting the winter snow, is a protection against warm summer rains, and cuts off radiation—acting as a protector against heat, and tempering the cold. The caves vary greatly in their positions, shapes, and sizes. They are found in various parts of Europe, Asia, and America, mostly in the smaller ranges or in the outliers of the snowy ranges, generally in limestone and occasionally in basaltic formations. Many are found in the Jura, a few in Switzerland, a few in the Italian Alps, a number in the eastern Alps; there are some in Hungary, several in Russia, one on the Peak of Teneriffe, several in Siberia, one in Kunduz in central Asia, one in Japan, and one in Korea. Twenty-nine places are mentioned

where subterranean ice occurs in North America, two of which are in Pennsylvania The dimensions of the caves vary greatly, some being great halls, three hundred or four hundred feet long, and some small tunnels in which one can not stand up straight. The forms assumed by underground ice are different from those visible in glaciers or icebergs. There are no *séracs* or crevasses, but stalactite forms are very common. The ice in the bottoms follows the shape of the floor. Sometimes ice is found in them of the peculiar structure called prismatic—breaking into regular prisms. Holes or runnels are formed in the lowest parts of the ice floors, where they are cut out by the melting water; and lakes and pools sometimes occur in them.

Scientific Palmistry.—The character and direction of the movements of the digits both in hand and foot, Sir William Turner observed in his anthropological address at the British Association, are imprinted on the integument of palm and sole. In the palm of the human hand the oblique direction of the movement of the fingers toward the thumb, when bent in grasping an object, is shown in the obliquity of the two great grooves which cross the palm from the root of the index to the root of the little finger. The deep curved groove, extending to the wrist, which marks off the eminence of the ball of the thumb from the rest of the palm, is associated with the opponent action of the thumb, which is so marked in man that the tip of the thumb can be brought in contact with a large part of the palmar surface of the hand and fingers. Faint longitudinal grooves in the palm, situated in a line with the fingers, express slight folds which indicate where the fingers are approximated to or separated from one another in adduction and abduction. In some hands a longitudinal groove marks off the muscles of the ball of the little finger from the rest of the palm, and is associated with a slight opponent action of that digit, by the combination of which with a partial opposition of the thumb the hand can be hollowed into a cup —the drinking cup of Diogenes. These grooves are present in the infant's hands at the time of birth, and the author has seen them in an embryo. They appear in the palm months before the infant can put its hand to any use. They are not, therefore, acquired after birth. Grooves are also seen in the palm of the hand of the anthropoid apes, differing in various respects from those of man, and respectively characteristic of the group in which they are found.

The Psychology of Humor.—A recent number of the American Journal of Psychology contains an inquiry into the psychology of "tickling laughter and the comic," by Prof. G. Stanley Hall and Arthur Allin. Their material was obtained by means of a widely circulated syllabus, sent with the request that the questions be answered, and the sheet then returned to the authors. About seven hundred answers were received, many of these from school teachers having the supervision of a number of pupils, so that the real number of individuals heard from amounted to probably three thousand. The authors discuss the answers received, and then go on to a consideration of the general subject. The many theories since Aristotle, concerning wit and humor, are shown to be either purely speculative or extremely circumscribed in the range of their induction and hence furnishing no foothold for further research. Among the older conceptions of the essentials of humor mentioned is Hobbes's: "The passion of laughter is the sudden glory arising from some sudden conception of some eminence in ourselves, by comparison with the inferiority of others, or with our own formerly." Dryden defined wit as a "propriety of thoughts and words, or thoughts and words elegantly adapted to the subject." Dr. Johnson thought it "a combination of dissimilar images or discovery of occult resemblances in things apparently unlike. Richard Blackstone conceived it as "a series of high and exalted ferments." Kant defines laughter "as an affection arising from the sudden transformation of a strained expectation into nothing." Mr. J. L. Ford says: "Careful study of the work turned out by professional joke-makers reveals the fact that fully nine tenths of their humor is founded on the simple idea of disaster or misfortune. . . . For a great many years nearly all our national humor had for its foundations the mother-in-law, the goat, the stove-pipe inebriety, and the banana peel." The authors

find as a result of their inquiry that all current theories are speculative and inadequate; they offer several good suggestions for a further study of the subject, two of which are the use of the camera and phonograph as automatic registers. The most important result of the inquiry seems to be the setting forth of how little we know about this department of mental phenomena.

The Blue Jay's Food.—A recent inquiry by F. E. L. Beal, assistant of the United States Department of Agriculture, into the food of the blue jay resulted in some unexpected results. The bird is distributed over the whole of the United States east of the great plains, and has a bad reputation, being charged not only with habitually robbing the nests of smaller birds of their eggs and young, but also with being very destructive to the farmer's grain. Mr. Beal examined two hundred and ninety-two stomachs in all. The remains of a small bird were found in two of these and portions of eggshells in three. He found that vegetable stuff made up three quarters of the blue jay's food, a good share of which is nuts and mast and wild berries. Their insect food makes up about twenty-three per cent of the whole, and consists largely of noxious and destructive sorts. He concludes as follows: "The most striking point in the study of the food of the blue jay is the discrepancy between the testimony of field observers concerning the bird's nest-robbing proclivities and the results of stomach examinations. The accusations of eating eggs and young birds are certainly not sustained, and it is futile to attempt to reconcile the conflicting statements on this point, which must be left until more accurate observations have been made. In destroying insects the jay undoubtedly does much good. Most of the predaceous beetles which it eats do not feed on other insects to any great extent. On the other hand, it destroys some grasshoppers and caterpillars and many noxious beetles, such as scarabæids, click beetles, weevils, buprestids, chrysomelids, and tenebrionids. The blue jay gathers its fruit from Nature's orchard and vineyard, not from man's. Corn is the only vegetable food for which the farmer suffers any loss, and here the damage is small. In fact, the examination of nearly three hundred stomachs shows that the blue jay certainly does far more good than harm."

MINOR PARAGRAPHS.

As the result of some recently conducted experiments on feeding hogs, it is announced by the Cornell University experiment station that fully twenty-five per cent of the diseases which are supposed by the farmer to be hog cholera, or some other of the infectious diseases which attack hogs, are simply due to unhealthy food or foul surroundings. It was found, among other things, that the dishwater from hotels (which forms the basis of the ordinary swill fed about towns) was especially injurious when any of the powdered soaps had been used for dishwashing purposes, and a large number of deaths among several herds were traced to this cause. The amount of free alkali, over fifty per cent, which is present in these soap powders in the shape of sodium carbonate (ordinary washing soda) was found to be the dangerous substance.

Is it possible, asks a writer in the *Revue Scientifique*, "to affirm positively that any particular medicine is injurious or any treatment bad? Assuredly not; what we condemn to-day will be good to-morrow. Did not the Sorbonne condemn quinine, tartar emetic, and antimony as injurious medicines? It was the same with transfusion. Science is revolutionized every moment by new discoveries. A doctor practicing laparotomy thirty years ago as it is practiced now would have been regarded as guilty of imprudence; yet the operation is very easily performed, perhaps too readily. There was a time when to give more than a gramme and a half or two grammes of iodide of potassium would have been a great fault; now, eighteen and even twenty grammes are given. Twenty-five years ago some doctors and even academicians denied that smallpox was contagious."

Dr. Brinton, in a recent number of Science, calls attention to a paper by the Marquis de Nadaillac on The End of the Human Race, and comments as follows: "Making anew the calculation of the increase of population as compared with the increase

of food supply, he reaches the gloomy conclusion that in a few centuries there will inevitably be too little food to supply all the mouths. Russia alone, at its present rate of births, will in one hundred years be obliged to feed eight hundred million persons. What, he asks, can stem this overwhelming tide of population? He gives up the problem, and says we must leave it to God, a solution which is more creditable to his piety than to his position as a scientist. The real solution is to educate men and women to the point where they will not recklessly produce offspring, nor yet ruthlessly prevent them, as is the case now in some departments of France. Unfortunately, prejudice stands in the way of a fair and free discussion of this solution."

LIKE our bison and the giraffe, the African wildebeest, or white-tailed gnu, is at the point of extinction. It is computed, the London Spectator says, that there are only about five hundred and fifty of these animals surviving in a wild condition, though they were at no great distance of time numbered by tens of thousands. Four herds are mentioned as still surviving in the Orange Free State, three of about one hundred each, which are fenced in, and one belonging to a wealthy Boer farmer, Mr. Piet Terblans, consisting of some two hundred and fifty animals, running perfectly wild, but protected on his wide domain by the vigilance of his sons and black servants. Having found the dead bodies of twenty-seven of these animals, all shot at one drinking place on the same day, from only one of which the skin and meat had been taken, he determined to stop the slaughter and did it. His farm is thirty square miles in area, and the wildebeests seem to be aware that they are exposed to danger elsewhere. They will go twenty miles in a night to feed upon some particularly good grass on other land, but gallop back to sanctuary at sunrise.

NOTES.

THE Report of the New York or American Section of the Society of Chemical Industry for 1896–'97, Dr. H. Schneitzer, New York, local secretary, speaks of the continued growth and prosperity which the section, as well as the society at large, enjoyed during the year. Seventy-nine members were added to the New York section, and the number of members residing in America is now four hundred and seventy-one. Seven general meetings were held during the session representing the year, at which, besides the opening address of Chairman C. F. Chandler, twenty-four papers were read, most of which have been published in the Journal of the Society in London. The society is regarded by its promoters as a necessary addition to the existing Chemical Society, its aims being the promotion of the industrial and manufacturing branches of chemistry.

THE British Association at its recent meeting made appropriations for grants for scientific purposes amounting to £1,350. The sum was larger than had been voted for several years, because the committee desired to make some grants for the pursuit of local investigations, to be expended by the various committees which had been appointed for the purpose of study and research in Canada. These committees relate to the establishment of a meteorological observatory on Montreal Mountain, Canadian photographs of geological interest, the biology of the lakes of Ontario, the industrial and social conditions of the northwestern Indian tribes, the organization of an ethnological survey of Canada, and the establishment of a biological station in the Gulf of St. Lawrence.

PROFESSOR LEONARD has recently shown that cathode rays in air form regions of mist condensation. A jet of steam, a short distance from the aluminum window of a Crookes tube, becomes of a bright whiteness and of a cloudy nature. The cathode rays seem to act far more powerfully than the X rays in this way. A. Paulsen has formed a cathode-ray theory of the northern lights.

THE scientific value of Prof. O. C. Marsh's collections just presented to Yale University can not be overestimated. Perhaps the most important of these is the collection of vertebrate fossils, which contains the famous series illustrating the genealogy of the horse. The only conditions attached to the gift are those necessary to insure the permanent care and preservation of the collections themselves.

THE Franklin Institute of Philadelphia is making part of its building fireproof, for the safer storage of its valuable library. In connection with the change a much larger space will be provided for the reading room and for the display of models and apparatus and for general museum purposes.

BLEEDING has long been discarded by the doctors, but if the experiments of the Russian physiologist Essipor have any significance there may be some virtue in it, after all. This gentleman has found that an abundant drawing of the blood has important effects on the chemical composition and properties of what is left. After drawing large quantities of blood, amounting to as much as

one fortieth the weight of the body, from rabbits, guinea-pigs, and pigeons, Mr. Essipor affirms that the fluid acquired a marked bactericidal power, particularly against the microbe of cholera. The effect took place gradually, and attained its maximum in about twenty-four hours. At the same time the animal became refractory against inoculations.

EDWARD GERMANO recently conducted a series of experiments to determine the time which the typhoid bacillus could retain its vitality under various conditions. The results showed that in dry air the cultures were dead within twenty-four hours, but in moist warm air they retained their vitality for sixty days. He concludes that aërial transmission in the ordinary acceptation of the term—that is, being blown about as dust or as a miasm in the wind from infected districts—is highly improbable; but that in imperfectly disinfected and *apparently* dry blankets and woolen clothing the microbes may retain their vitality for some time and be conveyed long distances.

SOME recent experiments by Professor Oliver and Dr. Bolam on the immediate cause of death by electric shocks seem to indicate that death is due to a sudden arrest of the heart's action and that simultaneous failure of the respiratory center and the heart, except with unusually high voltage, is very rare. It follows from this that resuscitation in apparent death from electric shock is made much more difficult than if the fatal result were brought about by respiratory failure.

THE oldest oak tree in France, the St. Bernard oak at Cunfin, is more than eight hundred and twenty-five years old, having been planted in A. D. 1070, and is mentioned in the *Annales ecclésiastiques du Diocèse de Langres*. It measures twenty-two feet in circumference at the collar of the roots, and is forty-two and a half feet high to the first branches. The trunk is hollow, and the wood has nearly all disappeared, leaving little else than the bark, which, too, has been eaten away in spots; one of the holes is large enough to let a man inside. A niche was made in the upper part of the trunk by the curé of Cunfin in 1749, and the statue of the Virgin was placed in it. That was swept away during the Revolution, but the old tree still lives.

A BLUFF of clay marl capped with yellow gravel, fronting Raritan Bay, near Cliffwood, N. J., the extreme northeastern exposure of the cretaceous clay and marl outcrop of the State, is a source from which collections of the fauna have been made, and the only spot where the flora of the horizon has been observed. It has been explored geologically by Messrs. Arthur Hollick, Lester F. Ward, and N. L. Britton, who have collected considerable material from it. The specimens, as a whole, are not very satisfactory, consisting of poorly preserved mollusks, fragments of crustaceans, fruit, leaves and branches of trees, and masses of lignite, many of them occurring in ferruginous concretions which soon disintegrate on exposure to the air. Mr. Hollick, in his paper describing and figuring them, notices twenty-six species of plant remains, ten of which are apparently new.

THE result of a careful study of four hundred alcoholics by Forel, of Zurich, again emphasizes the great importance of heredity. Forty-three per cent of the cases had one or both parents alcoholic. Fifteen per cent of the patients were wholesale or retail liquor dealers. All cases showed various physical, mental, and moral alterations. Fourteen per cent were epileptics.

A COMPARISON of the fossil foraminifera of the marine clays of Maine is adduced by Mr. F. S. Morton, in a communication to the Portland Society of Natural History, as furnishing additional evidence that the climate when they were deposited was very much colder than now. Many of the forms are still found living in the Gulf of St. Lawrence, but the forms found still farther north more perfectly agree with them. Those found by the late H. B. Brady in the shallow-water dredgings from the Novaya Zemlya Sea are almost identical with the Maine fossil forms.

DR. DAWSON WILLIAMS, who has been connected with the editorial staff of the British Medical Journal for seventeen years as assistant editor under Mr. Ernest Hart, has been appointed editor-in-chief to succeed the latter.

IN the list of recent deaths of men associated with science are recorded the names of Arthur Kammermann, astronomer, at Geneva, Switzerland, December 15th, aged thirty-six years: Prof. Knud Styffe, director of the School of Technology at Stockholm, a great authority on iron and steel and author of a report on The Elasticity, Extensibility, and Tensile Strength of Iron, which has been translated into English, February 3d, in his seventy-fifth year; Jean Albert Gauthier Villars, printer to the French Academy of Sciences, and publisher of the works of Lagrange, Fermat, Fourier, Cauchy, and other scientific investigators, February 5th, at the age of sixty-nine years; Dr. Rudolf Leuckart, professor of zoölogy and zoötomy at Leipsic, February 7th, aged seventy-four years; and John Carrick Moore, an eminent geologist in the earlier part of the century, author of papers on Silurian strata, Tertiary fossils of Santo Domingo and Jamaica, Erosion of Lake Basins, and the Influence of the Obliquity of the Ecliptic on Climate; in London, February 10th, in his ninety-fifth year—a nephew of Sir John Moore.

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"All those who are engaged in teaching elementary science learn the need of limiting the story they have to tell to those truths which can be easily understood by beginners. It is sometimes best, as in stating such difficult matters as those concerning the tides, to give explanations which are far from complete, and which, as to their mode of presentation, would be open to criticism were it not for the fact that any more elaborate statements would most likely be incomprehensible to the novice, thus defeating the teacher's aim.

"It will be observed that no account is here given of the geological ages or of the successions of organic life. Chapters on these subjects were prepared, but were omitted for the reason that they made the story too long, and also because they carried the reader into a field of much greater difficulty than that which is found in the physical history of the earth."—*From Preface.*

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GEORGE MOORE'S NEW NOVEL.

Mr. Moore's comparative silence for the last few years has been due to his preoccupation with his most serious and important work which is now given to the public. This novel is a masterly analysis of a conflict between art and the world on one side and religion upon the other. The theme is developed with a penetrating insight into motives, a grasp of character, and a mastery of literary technique which make *Evelyn Innes* a notable book, and a genuine addition to modern English literature. The action of the novel passes in large part in London and Paris. It is a story of the present day characterized by a vivid perception of the doubts and complex conditions of modern life. The musical motif which has so large a part in the development of the story is interwoven with others which in their unfolding show a rare subtlety and power of expression. That Mr. Moore is an artist has long been known to cultivated readers, but his admirers will find that in *Evelyn Innes* he shows himself a force to be reckoned with anew by students of the best in modern letters.

***

In the preface to his *History of Italian Literature* Dr. Garnett says: "The literature of Italy requires to be constantly considered in connection with other literatures, both those from which it is itself derived and those which it has deeply influenced. It is more intimately affiliated to antiquity than any other European literature, and may indeed be regarded as a continuation or revival of the Latin. Its advent was long and unaccountably delayed—it is the youngest of all the chief European literatures; but when at length it did appear, its form, already classical, dispensed it from an infancy of rudeness and barbarism. Entering at once upon a heritage of classical tradition, Italians began to teach foreign nations long before they found anything to learn from them; and this influence is so large a part of the glory of Italy that her literature can not be fully unlocked to the foreigner unless he is shown, not only what she has herself effected in letters, but how greatly she has modified the intellectual development of other countries. She owes nothing to Chaucer, Spenser, or Milton; but Chaucer, Spenser, and Milton are infinitely indebted to her. The position she so long retained as the instructor and exemplar of civilized nations invests her literature with an importance more considerable than that attaching to the merits of her individual authors, illustrious as these are.

Yet it is impossible to elucidate this momentous department of the subject in a manual of four hundred pages. All that can be done is to indicate by continual reference and allusion that the need exists, and must be satisfied elsewhere. The influence upon Italy herself of foreign writers, and of movements common to Europe in general, has required and received fuller treatment."

* * *

The Psychologic Foundations of Education, by Dr. William T. Harris, United States Commissioner of Education, is one of the most important of recent educational publications. A book by the distinguished editor of the International Education Series on so weighty a subject as the title of this volume indicates has, since its announcement a year ago, been awaited with great interest by educators everywhere, and its appearance is a notable event in the history of pedagogical literature. The work is not simply an inventory of the mental faculties as many psychologies are, but is an attempt to show the psychological foundations of the more important educational factors in civilization and its schools, and it is treated in the masterly style of which the philosophical mind of its author is capable. Dr. Harris has shown, what no other writer has in so clear and practical a manner, the true relations of psychology to the education of youth. He presents a psychology that shows how all the activities of life, social or otherwise, react on the child and the man to develop them. He shows the educative influences, not only of school work but of the family, industrial occupations, of play and work, of state, church, and of all national life. His book is a masterpiece of psychologic and pedagogical literature.

* * *

Mr. Rowley, author of *The Art of Taxidermy*, is the author of the magnificent groups of mounted animals in the hall devoted to North American mammals at the American Museum of Natural History. He has introduced new features into the art which have not been described in print before, and his book will represent the latest advances in taxidermy as an art and as a science. He takes a hunting party to the Canadian woods in his opening chapter, and gives a series of vivid pictures of actual field work. This is followed by a series of careful explanations of the proper treatment of animals, large and small, of birds, and heads. The many lovers of outdoor sport who are interested as amateurs in the various phases of taxidermy will find their requirements fully met, while to professional taxidermists this important and comprehensive work will be indispensable. It will be elaborately illustrated.

* * *

In *Arachne*, Dr. Ebers returns to the Egyptian field in which he has gained such wide popularity. The story opens in 274 B. C. The opening scenes are laid in a little town near the Nile Delta, and later the movement of the romance transfers the reader to Alexandria. The outline of the story is as follows: Two young sculptors, devoted friends, receive a commission for two statues. Hermon, the hero, is to execute Demeter and Arachne. A handsome Greek, he compliments fair women, seeking among them models. One, a Biamite girl, seems to him best suited for his Arachne, and he wins her love; but on the evening he has promised to meet her on an island he attends a banquet where, captivated by the charms of another woman who for the entertainment of the guests personates several characters (among them Arachne), he lingers, breaking his appointed tryst. Ledscha, infuriated, promises a sea-rover her hand if he will capture the sculptor alive and destroy his statues. In the fray another, by mistake, is carried on board the pirate ship, but Hermon is blinded by having a torch thrust in his face. In his darkness he realizes his

love for Daphne, whom he has known from childhood, and later his sight is restored and the pirates are captured and executed. This is but a barest skeleton of a book which will have many readers. There is a great deal of incident, and the description of the girl personating the various characters, especially where she assumes that of Arachne, is a vivid and noteworthy feature.

***

Mr. H. N. Brailsford, author of *The Broom of the War God*, a story of the late war between the Greeks and Turks, which Messrs. D. Appleton and Company recently published, fought in the war as a volunteer in the Foreign Legion. Mr. Brailsford is a Scotchman, educated in Dundee, and a Fellow of Glasgow University. This remarkable picture of the actual conditions in the Greek army during the recent war is drawn by a new author of exceptional promise. There are glimpses of Lamia, Pharsala, Larissa, Volo, Velestino, and Domoko. The author was one of the disorganized and leaderless assemblage which constituted the Greek army, and his wonderfully graphic sketches of the conditions in the ranks, the incompetence of officers, and the attitude of the King and Crown Prince toward the war, shed a new light upon the disasters of the campaign. The hero, an Englishman, embodies the characters and the feelings of his strangely assorted cosmopolitan comrades, and illustrates the psychology of war as displayed in a hopeless campaign.

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A Voyage of Consolation is the title of the new book by Mrs. E. C. Cotes (Sara Jeannette Duncan) which has been published recently by D. Appleton and Company. In this book Mrs. Cotes returns to the field which she developed with such success in "A Social Departure" and "An American Girl in London." Some characters which delighted thousands of readers reappear in this new book, and their entertaining experiences on the Continent are set forth with unfailing good spirits and an apt appreciation of the picturesque and humorous features of European travel. The text is admirably supplemented by vivacious illustrations.

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An early second edition of Mr. E. Hough's graphic *Story of the Cowboy* indicates the continued success of the novel plan adopted for the presentation of Western history in the popular Story of the West Series, published by D. Appleton and Company.

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In a recent newspaper interview Mr. Anthony Hope expressed his preference for *The God in the Car* among all his books. A new edition of this novel has just been issued by Messrs. D. Appleton and Company, uniform with Mr. Hope's *Chronicles of Count Antonio.*

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The increasing interest in American historical themes is well illustrated by the success of Henry Johnson's instructive and fascinating *Exploits of Myles Standish*, recently published by D. Appleton and Company. While his story is full of romantic interest, it conveys truthful pictures of the life of the Plymouth colony which attract older as well as younger readers.

***

The father of Paul and Victor Margueritte, the authors of *The Disaster* served with distinction in Algeria, where his sons were born, and was made a general at the age of forty-seven. At that time he was the youngest officer of that rank in the French army. He died in September, 1870, of a wound received while leading his men in a charge upon a Prussian corps at Sedan. In addition to his remarkable qualities as a soldier, General Margueritte possessed the gift of literary expression in a marked degree. By inheritance, therefore, the au-

thors of *The Disaster* were well equipped. Paul, born in 1860, has devoted himself to literature from his youth. Victor, born in 1866, had nine years of military service. Their collaboration dates back nearly three years when they began work upon *The Disaster*. Upon the publication of such a work as *The Disaster*, it is not unnatural that some comparison should be made with M. Émile Zola's work, "La Débâcle," though in many ways the two works differ to a considerable extent. It may be as well to point out in what respect. M. Zola has depicted the disorganization of the Châlons army and the Sedan catastrophe. The Margueritte narrate the heroic struggle of the army of the Rhine at Borny, Rezonville, Saint-Privat, and Noisseville; the long agony of the finest troops in the French army, day after day duped until the fatal hour of the capitulation of Metz by Bazaine. In "La Débâcle" we have a vivid picture of war from the common soldier's point of view; In *The Disaster* we have a description of war as seen by the officers. Pierre du Breuil, the hero of the story, is an officer of the general staff, and an orderly officer of the Minister of War. He is, consequently, at the very center of the military movement. At the time of the declaration of war against Germany, he has, like nearly everybody else, illusions which by degrees are destroyed as the war continues and the country is invaded. The Margueritte have described the struggle between the conscience and the sense of duty of this officer, between discipline and revolt; the brilliant soirée at the palace of Saint-Cloud, the departure of the imperial train for Metz, Paris at the opening of the war, the disorganization of the army during the first few days of the campaign, the battlefields, the ambulances, the feverish excitement at Metz, the stagnation of the army in the rain and the mud, the horses disappearing by hundreds to provide food for the soldiers, the inhabitants of the Lorraine town encircled by Prussian troops, and, in conclusion, the heartrending scenes of the capitulation.

It will be found that considerable space is devoted to the suspicious conduct of that remarkable man, Marshal Bazaine. *The Disaster* is, indeed, in many respects a character study of the man whose ambition led to his trial for treason, his sentence to death, and, after his escape from Fort Sainte-Marguerite, on August 10, 1874, his death in Spain in obscurity.

Unlike M. Zola's novel, *The Disaster* contains its lesson; it is calculated, despite its sadness, to sustain, not to cast down. The author of "La Débâcle" gives a picture of war upon a majestic scale after the fashion of a Tolstoi; Paul and Victor Margueritte belong to a younger school of writers, their descriptions of battle scenes being more episodic than the novelists already mentioned, so that at times the reader is almost reminded of the work of Stephen Crane in "The Red Badge of Courage."

But the Margueritte have not given us a book wholly devoted to military matters. The affection of Du Breuil's friend Lacoste for his dog Titan and his horses Musette and Conquérant; the hero's love for Anine, besides many other incidents and characters too numerous to mention, serve to add brightness to a picture which might otherwise have been gloomy and monotonous. Sometimes we come across a description almost Stevensonian in its charm, as, for instance, that which puts before the reader the little cavalry soldier Jubault playing on his flute in a stable at dead of night the air of "Marlbrough s'en va t'en guerre," the melody striking upon Du Breuil's ears above the silence of the Ban Saint-Martin "like an ironical and sad streamlet of water."

* * *

The Chevalier de Pontgibaud, the hero of *A French Volunteer in the War of Independence*, "was one of the gallant little band of Frenchmen who,

sick for breathing and exploit, crossed the Atlantic to aid the American colonists to gain their independence. Like most of his companions, he was a mere lad, courageous, adventurous, high-spirited, light-hearted, and cool-headed, but he united to these ordinary attributes of the French gentleman one which his comrades did not possess, or had no opportunity of developing. He seems to have been a shrewd observer of men and events, and he had a keen sense of humor.

Concerning the author's life, little need be added to what he tells us, but I am indebted to his great-great-nephew, the Comte de Pontgibaud, for some details which are not to be found in the book. The Chevalier de Pontgibaud married (July 31, 1789) a daughter of Maréchal de Vaux, and the widow of Comte de Fougières, *maréchal de camp*. He was deeply attached to her, and only survived her a few months. She died in 1836, and he in 1837. From the time of his return to France (1814) till his wife's death he resided at 6 Place Royale, Paris, but afterward removed to the residence of his nephew, Comte de Pontgibaud, 32 Rue des Tournelles, where he died.

He was a genial, kind-hearted man, and it is related of him that in his later days he never left home without a pocketful of five-franc pieces, one of which coins he would bestow on each poor person he met. "As I want for nothing myself," he said, "let me do all I can for poor people who do want." Indeed, had it not been for his charitable disposition, he would never in all likelihood have written his book. His cousin, Mme. de Lavau, who was interested in many charitable works, said to him one day: "My dear cousin, you have had such an adventurous career that an account of the principal events of your life would make a most interesting book. I would give away the copies as prizes in a lottery, and I warrant we should get a large sum for one of my charities." The proposal was perhaps hardly flattering to the author, but he was too kind-hearted to refuse, and the book was duly written.

The Mémoires du Comte de M—— (the writer was then known as the Comte de Moré) has become a rare book, and appears to have been unknown to many of the historians and biographers whose writings relate to the War of Independence and the actors concerned in it. That the book is rare and rather valuable is due to the "book-maniacs," who have snapped up every available copy, not on account of any interest in the book or its author, but because of—the printer! A certain young man had persuaded his relatives to set him up in business as a printer, but in a little over a year he contrived to lose more than 150,000 francs. He threw up the business in disgust, and resolved to make his living by the pen. To prove that he was better fitted to compose with the pen than with the "stick," it needs but to cite his name—Honoré de Balzac! Even a book which had the honor of proceeding from the novelist's unprofitable press has acquired a fictitious value.

Both as the Chevalier de Pontgibaud and the Marquis de Moré, the author had the good sense to keep out of politics, and his name occurs but rarely in memoirs and histories of the day. In Vatel's Vie de Madame du Barry he is mentioned as being present at a dinner party to which she was invited. The incident is related in the MS. Memoirs of Comte Dufort de Cheverny. "Seeing that the chevalier wore the Order of Cincinnatus, she told us the following story: 'When I was at Versailles I had the six tallest and best-looking footmen that could be found, but the noisiest, laziest rascals that ever lived. The ringleader of them gave me so much trouble that I was obliged to send him away. The war in America was then beginning, and he asked for letters of recommendation.'"

One of the most interesting literary events of recent years was the introduction of M. Félix Gras to the English-speaking world by Messrs. D. Appleton and Company. *The Reds of the Midi* was the first book ever translated from the Provençal and published in English before it appeared in France. Mrs. Janvier's admirable and sympathetic translation and Mr. Janvier's appreciative introduction contributed much to the enjoyment of the many readers who welcomed this new and striking figure in modern literature. Although M. Gras had earned a high reputation in the Midi, where his verses are held in honor, and he himself is the President of the Felibrige, he was wholly unknown to English readers up to the time that Messrs. D. Appleton and Company published Mrs. Janvier's translation of *The Reds of the Midi*. It is possible now to gratify the many inquirers for another romance by M. Gras with the announcement of the early publication of his new novel called in French *La Terreur*. Although the story stands by itself, and may be read independently with no loss, certain characters of "The Reds" reappear in the new book, *La Terreur*, of which the French version as well as the English has been copyrighted in the United States by the Messrs. Appleton. *The Reds of the Midi*, as explained, is complete as it is. *La Terreur* describes "The Red Terror" in France. The new romance relates the history of the year for which Pascalet was absent, and of some years more. It describes the sufferings and persecution of the heroine Adeline as an "aristocrat," thus furnishing a point of view of the Revolution which is the opposite of that presented in *The Reds of the Midi*.

The central motif of the romance, developed with singular sympathy by the author, is the picture of a young girl's feelings when thrown into the vortex of the French Revolution. The action passes for a time in Paris, and then in Avignon.

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The great popularity of Mr. F. Schuyler Mathews's charmingly illustrated books upon flowers, trees, and roadside life insures a cordial reception for his forthcoming book, *Familiar Life of Field and Forest*, which describes the animals, reptiles, insects, and birds commonly met with in the country. His book will be found a most convenient and interesting guide to an acquaintance with common wild creatures.

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The success of Mr. Edgar S. Maclay's *History of the United States Navy* has been assured from the first. The book has been conceded to meet the demand for an authoritative history, and no other writer is likely to devote the time and research to the subject which Mr. Maclay gave to his book. Altogether more than twelve years passed between the beginning and completion of a work which involved a vast amount of research in London and Paris as well as in Washington and other American cities. While this standard work has passed safely through the tests of criticism, it has become desirable to add various features of our naval history which have presented themselves since publication. Furthermore, the large number of letters brought out by the book have contained suggestions of value, and it has been possible to note some slight errata. The author therefore has been engaged for some time in the preparation of a revision which will bring his book up to date. In the present period of interest in naval matters this new edition will be peculiarly welcome, since the history occupies a place by itself in our naval literature. The new edition will contain the latest presentation of the standing and resources of our navy.

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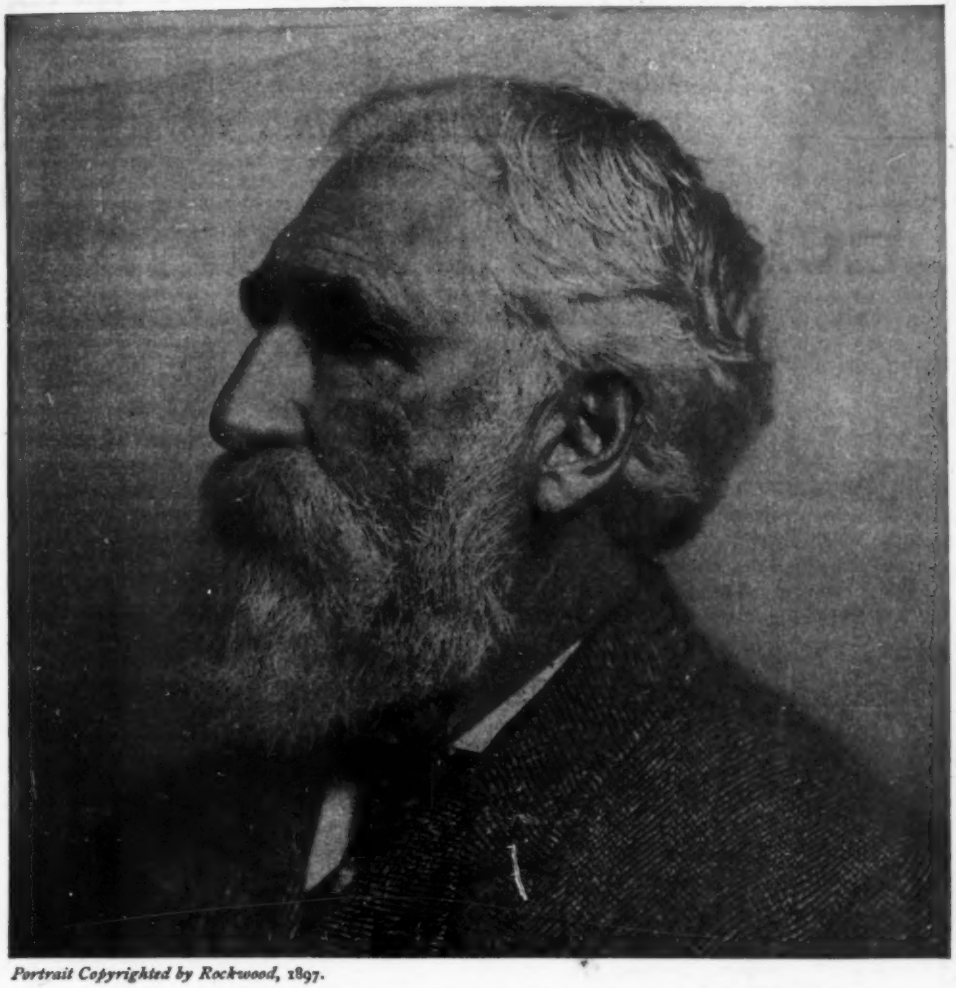

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PERIODICALS.	AUTHORS.
Westminster Review,	Rt. Hon. W. E. Gladstone,
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Chambers's Journal,	Prince Kropotkin,
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The Athenæum,	St. George Mivart,
Public Opinion,	Rev. H. R. Haweis,
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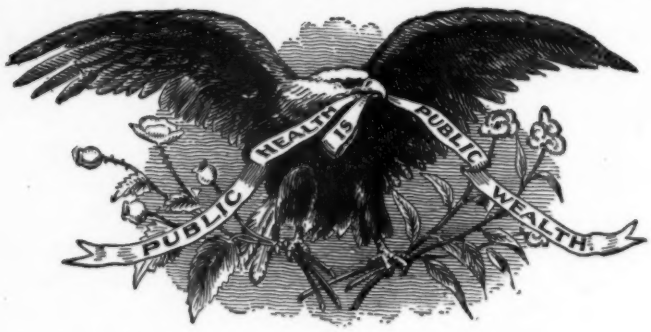

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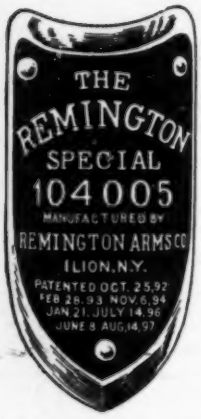

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JAMES G. BATTERSON, President.

Hartford, Conn., January 1, 1898.

Paid-up Capital, $1,000,000.

ASSETS.

Real Estate	$1,994,465 31
Cash on hand and in Bank	1,355,412 83
Loans on bond and mortgage, real estate	5,906,610 72
Interest accrued but not due	227,730 38
Loans on collateral security	945,400 94
Loans on this Company's Policies	1,106,580 51
Deferred Life Premiums	299,990 19
Premiums due and unreported on Life Policies	228,448 75
United States Bonds	14,000 00
State, county, and municipal bonds	3,612,646 78
Railroad stocks and bonds	4,664,205 75
Bank stocks	1,064,047 00
Other stocks and bonds	1,449,455 00
Total Assets	**$22,868,994 16**

LIABILITIES.

Reserve, 4 per cent, Life Department	$16,650,062 00
Reserve for Reinsurance, Accident Department	1,365,817 22
Present value Installment Life Policies	426,288 00
Reserve for Claims resisted for Employers	299,066 30
Losses unadjusted	269,794 94
Life Premiums paid in advance	25,330 58
Special Reserve for unpaid taxes, rents, etc.	110,000 00
Total Liabilities	**$19,146,359 04**
Excess Security to Policy-holders	**$3,722,635 12**
Surplus to Stockholders	**$2,722,635 12**

STATISTICS TO DATE.

LIFE DEPARTMENT.

Life Insurance in force	**$91,882,210 00**
New Life Insurance written in 1897	**14,507,249 00**
Insurance issued under the Annuity Plan is entered at the commuted value thereof as required by law.	
Returned to Policy-holders in 1897	**1,235,585 39**
Returned to Policy-holders since 1864	**13,150,350 57**

ACCIDENT DEPARTMENT.

Number Accident Claims paid in 1897	**$ 15,611 00**
Whole number Accident Claims paid	**307,990 00**
Returned to Policy-holders in 1897	**1,381,906 81**
Returned to Policy-holders since 1864	**21,210,095 96**
Returned to Policy-holders in 1897	**$2,617,492 20**
Returned to Policy-holders since 1864	**34,360,626 53**

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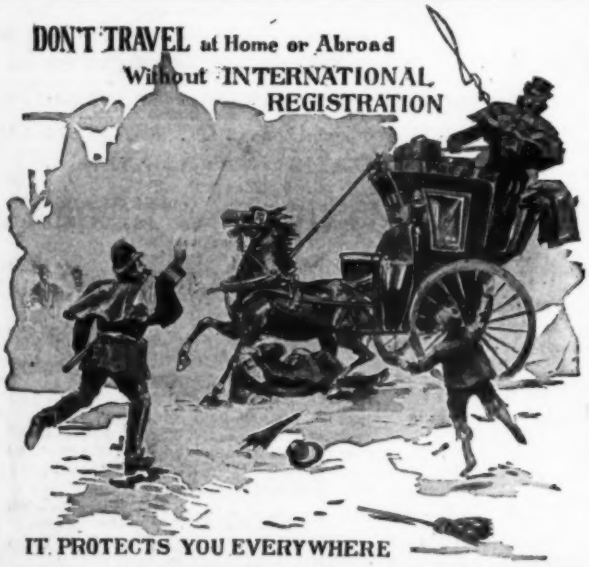

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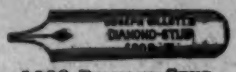

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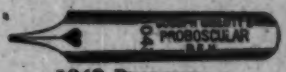

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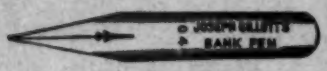

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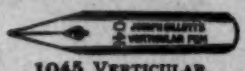

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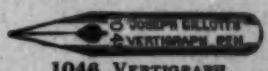

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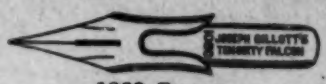

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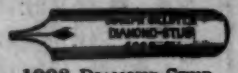

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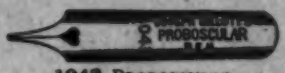

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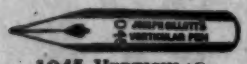

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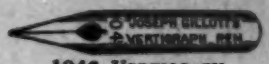

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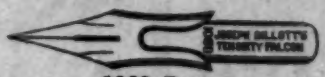

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